INTERNATIONAL STANDARD

ISO 7076-2

First edition
2012-05-15

Fire protection — Foam fire extinguishing systems —

Part 2: Low expansion foam equipment

Protection contre l'incendie — Systèmes d'extinction d'incendie à mousse —

Partie 2: Équipement pour mousse à faible foisonnement

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Reference number
ISO 7076-2:2012(E)

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Published in Switzerland

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 7076-2 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*.

ISO 7076 consists of the following parts, under the general title *Fire protection — Foam fire extinguishing systems*:

— *Part 1: Foam proportioning equipment*

— *Part 2: Low expansion foam equipment*

— *Part 5: Compressed air foam equipment*[1)]

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Fire protection — Foam fire extinguishing systems —

Part 2: Low expansion foam equipment

1 Scope

This International Standard specifies requirements and test methods for low expansion foam equipment of fixed-foam extinguishing systems for indoor or outdoor use or both.

This International Standard is applicable to sprayers, branchpipes, monitors, low expansion foam generators, foam chambers, etc.

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.

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 180, *Plastics — Determination of Izod impact strength*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 272, *Fasteners — Hexagon products — Widths across flats*

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 885, *General purpose bolts and screws — Metric series — Radii under the head*

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*

ISO 898-2, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread*

ISO 1179-1, *Connections for general use and fluid power — Ports and stud ends with ISO 228-1 threads with elastomeric or metal-to-metal sealing — Part 1: Threaded ports*

ISO 4633, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials*

ISO 4759-1,*Tolerances for fasteners — Part 1: Bolts, screws, studs and nuts — Product grades A, B and C*

ISO 7005-1, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

ISO 7005-2, *Metallic flanges — Part 2: Cast iron flanges*

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

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

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ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ASTM D638, *Standard test method for tensile properties of plastics*

ASTM G155, *Standard practice for operating xenon arc light apparatus for exposure of non-metallic materials*

3 Terms and definitions

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

3.1
branchpipe
component which projects foam in the form of a jet or spray

3.2
discharge coefficient (K factor)
"k" factor for the equation $K = \frac{Q}{\sqrt{10 \times P}}$

NOTE Q is the flow rate through the component in l/min and P is the inlet pressure in MPa.

3.3
foam chamber
component that incorporates a vapour seal, a foam expansion chamber, and which delivers foam into a flammable or combustible liquid storage tank

NOTE A foam generator may be connected to the foam chamber inlet.

3.4
foam expansion ratio
ratio of the volume of foam to the volume of the foam solution from which it was made

3.5
foam generator
component which introduces air into the foam solution stream for delivery against a low back pressure, i.e. discharge against atmospheric pressure

3.6
low expansion foam
foam which has an expansion ratio not greater than 20

3.7
monitor
component consisting of a branchpipe and turret

3.8
sprayer
open nozzle which discharges a spray of foam or foam solution

3.9
25 % drainage time
time for 25 % of the liquid content of a foam to drain out

3.10
vapour seal
frangible component designed to prevent tank content vapours from entering the foam pipeline system while allowing foam to flow into the tank during system operation

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3.11
high back pressure foam generator
component which introduces air into the foam solution stream for delivery against a high back pressure

NOTE For example, as is found in tank sub-surface injection.

4 Requirements

4.1 Connections

4.1.1 Permanent connections and joints

Permanent joints shall conform to ISO 7-1, ISO 228-1, ISO 1179-1, ISO 7005-1 or ISO 7005-2, as applicable, or shall conform to other technical specifications valid in the place of use where International Standards are not applicable.

4.1.2 Bolting of pressure-retaining parts

Bolts, nuts or studs or both used to fasten pressure-retaining parts shall conform to ISO 272, ISO 885 and ISO 4759-1, or shall conform to other technical specifications valid in the place of use where International Standards are not applicable.

4.2 Parts for removal during routine field maintenance

4.2.1 Removal

Parts intended for removal during routine field maintenance shall be accessible, removable and replaceable without damage using appropriate tools normally used by the trade, or special tools recommended by the component manufacturer.

4.2.2 Re-assembly

The design and construction of any part intended for removal during routine field maintenance shall be such that it cannot be re-assembled in a manner other than as intended.

4.3 Corrosion resistance of metal parts

Those parts of components that are exposed to foam concentrate or foam solution shall be resistant to corrosion from that exposure.

Those parts of components that are intended to freely move during operation or bear against, rotate within, or slide on stationary parts shall be of a corrosion-resistant material.

NOTE Bronze is a typical material that has corrosion-resistant properties when exposed to foam concentrate or foam solution.

4.4 Elastomeric joint rings

Elastomeric joint rings shall conform to the requirements of Type W of ISO 4633.

4.5 Plastics and reinforced resin materials

4.5.1 General

Plastic or reinforced resin components, which are essential to the operation or safety of the product, shall meet the relevant requirements of 4.5.2 and 4.5.3.

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4.5.2 Resistance to ageing

After ageing in accordance with 5.2 and the appropriate sections of ISO 527-1, ISO 179-1 and ISO 180, specimens of plastics and reinforced resin materials used for components shall:

a) have a tensile strength of no less than 50 % of the value before exposure;

b) have an elongation at break of no less than 50 % of the value before exposure; or

c) have an impact strength of no less than 50 % of the value before exposure (this method is relevant to stiff plastics, i.e. flexible plastics shall be evaluated using the tensile test);

d) show no signs of cracking.

4.5.3 Resistance to exposure to liquids

Plastics and reinforced resin materials which come into contact with foam concentrate, foam solution or water after exposure to the particular liquid in accordance with 5.3 and the appropriate sections of ISO 527-1, ISO 179-1 and ISO 180, shall

a) have a tensile strength of no less than 50 % of the value before exposure;

b) have an elongation at break of no less than 50 % of the value before exposure; or

c) have an impact strength of no less than 50 % of the value before exposure (this method is relevant to stiff plastics, i.e. flexible plastics shall be evaluated using the tensile test);

d) show no signs of cracking.

4.6 Strength

4.6.1 The pressure-retaining equipment shall withstand, without rupture, an internal hydrostatic pressure of four times the maximum working pressure for a period of 5 min when tested as specified in 5.4.

4.6.2 The calculated design load of any fastener, neglecting the force required to compress the gasket, shall not exceed the minimum tensile strength specified in ISO 898-1 and ISO 898-2 when the equipment is pressurized to four times the maximum working pressure. The area of the application of pressure shall be calculated as follows:

a) If a full-face gasket is used, the area of application of pressure is that extending out to a line defined by the inner edge of the bolts;

b) If an “O”-ring seal or ring gasket is used, the area of application of force is that extending out to the centre line of the “O”-ring or gasket.

4.7 Leak resistance

The pressure-retaining equipment, shall withstand, for 5 min without leakage, an internal hydrostatic pressure of 1,5 times the maximum working pressure specified by the manufacturer, when tested in accordance with 5.5.

4.8 Discharge coefficient (K factor)

The discharge coefficient (K factor) shall be within ±5 % of the value stated by the manufacturer when determined in accordance with 5.6.

4.9 Foam quality

The expansion and drainage time of foam produced by low expansion foam equipment, using the foam concentrate recommended by the manufacturer, shall conform to the manufacturer’s stated values when tested in accordance with 5.7.

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The foam concentrate characteristic value for foam quality (expansion and 25 % drainage time) as determined in accordance with ISO 7203-1 and ISO 7203-3 (as applicable) shall be considered in determining compatibility of low expansion foam equipment with the foam concentrate.

NOTE The expansion and drainage time of non-aspirated foam may be difficult to measure, and therefore there are no corresponding requirements for non-aspirating components.

4.10 Water flow

The low expansion foam equipment shall show no loose parts or leakage when tested in accordance with 5.8.

4.11 Range of discharge

The range of discharge of the foam branchpipe and monitor shall be not less than the manufacturer's stated values when tested in accordance with 5.9.

4.12 Vapour seal

Tests shall be carried out in accordance with 5.10 and shall meet the following requirements:

a) A vapour seal shall not rupture when a positive pressure difference of 0,02 MPa (0,2 bar) is applied to the upstream face;

b) A vapour seal shall rupture when the foam generator is operating at an inlet pressure of not less than 0,07 MPa (0,7 bar) and no more than 0,20 MPa or no more than the minimum inlet pressure subtracting 0,10 Mpa (1 bar), whichever pressure is less.

4.13 Operation reliability

The spring, slider and other movable parts of low expansion foam equipment shall be tested individually in accordance with 5.11. After testing, the movable parts shall be reinstalled in the low expansion foam equipment, and the equipment shall operate properly.

4.14 Stress corrosion

After being subjected to the conditions described in 5.12, a brass part containing greater than 15 % zinc shall comply with the following requirements:

a) show no evidence of cracking when examined using 25x magnification, or

b) if there is evidence of cracking of pressure-retaining equipment, comply with 4.6 at 2 times the maximum working pressure rather than 4 times the maximum working pressure, or

c) if there is evidence of cracking of equipment that is not pressure-retaining, comply with 4.10.

4.15 Salt-spray corrosion

After being subjected to the condition described in 5.13, equipment constructed from metallic parts using combinations of brass, bronze or ferrous metals shall show no destruction or damage which impairs function.

4.16 Light and water exposure

Following light and water exposure for 720 h, as specified in 5.14, an exterior polymeric or fibreglass component part or samples prepared from the same exterior polymeric or fibreglass component material:

a) shall show no evidence of cracking, and

b) A component part that need not be cut or altered in order to be subjected to the exposure shall function as intended when operated at its highest inlet pressure and highest flow rate for 2 min.

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c) A component part that needs to be cut or altered in order to be subjected to the exposure shall have physical properties not less than 60 % of the original as-received physical properties when subjected to tensile tests described in ASTM D638.

4.17 Heat and fire resistance

After being subjected to the condition described in 5.15, foam discharge devices intended to be installed in the area of fire shall show no destruction or damage which impairs function.

5 Test methods

5.1 General

The following tests shall be carried out for each type of low expansion foam equipment.

Tests shall be carried out at ambient temperatures of 20 °C ± 10 °C, unless other temperatures are indicated. Unless stated otherwise, the tolerances given in Annex A shall apply.

5.2 Ageing test for plastics and reinforced resin materials

Place five specimens of the material under test in an air tolerance oven at 100 °C ± 2 °C for 90 d. Allow to cool in air at 23 °C ± 3 °C for 24 h ± 4 h before testing.

NOTE Certain plastics require a lower oven temperature. In such cases, if the acceleration factors are unknown, it is assumed that the lowering of the temperature by 10 °C implies a doubling of the ageing time.

5.3 Liquid exposure test

Immerse five samples in each of the liquids with which the material comes into contact, in accordance with ISO 175, for 210 d at 50 °C ± 2 °C. Use the appropriate test liquid, i.e. potable water, seawater or foam concentrate or foam solution, recommended by the supplier.

5.4 Equipment pressurization test

The low expansion foam equipment shall be fastened in the test device. Any materials or parts that are not capable of withstanding test pressure should be removed or replaced by suitable ones. Blank off or plug all orifices. Fill the low expansion foam equipment with water, close the vent air and pressurize the hydrostatic pressure four times the maximum working pressure and maintain this pressure for 5 min. The test results shall meet the requirements of 4.6.

5.5 Leak resistance test

The low expansion foam equipment shall be installed on the pipeline. Blank off or plug all orifices, leaving one connection for pressurization and an outlet fitted with a suitable valve for venting air. Fill the equipment with water, close the air vent and pressurize from zero, at a rate not exceeding 0,2 MPa/s (2 bar/s), to not less than 1,5 times the maximum working pressure and maintain for 5 min. The test results shall meet the requirements of 4.7.

5.6 Flow coefficient measurement

Measurement is to be taken at an ambient temperature of 20 °C ± 5 °C with either water or foam solution.

The low expansion foam equipment shall be installed in the pipeline as intended. Record flow rates at the minimum, approximate median and maximum inlet pressures or more than these three inlet pressures.

The discharge coefficient (K factor) shall be calculated using the formula in accordance with 4.8, and the mean value of the K factor shall meet the requirement of 4.8.

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5.7 Measurement of expansion ratio and drainage time

The method in ISO 7203-1 shall be used to measure the expansion ratio and 25 % drainage time with the exception that the foam making nozzle described in Annex F of ISO 7203-1 be replaced by the equipment being tested. For a high back pressure generator, the foam sample is to be obtained from a valved test connection on the discharge of the generator.

Other than the exception described in the note below, foam is to be discharged at the minimum, normal and maximum inlet pressure.

NOTE Foam is to be discharged from a high back pressure generator at the minimum and maximum back pressure for both the minimum and maximum inlet pressure.

5.8 Water flow test

The low expansion foam equipment shall be installed in the pipeline as its intended use. The test sample shall be subject to continuous water flow:

a) for 10 min with the highest inlet pressure and flow rate as specified by the manufacturer;

b) for 3 min with 120 % of the highest flow rate as specified by the manufacturer.

The test results shall meet the requirements of 4.10.

5.9 Range tests for branchpipe and monitor

Set up the equipment to discharge foam using a foam solution or water and foam concentrate at the supplier's specified concentration using a concentrate specified by the equipment manufacturer.

Carry out the test at a wind speed of not more than 3 m/s. Direct the discharge downwind with the nozzle elevated at no greater than 30° to the horizontal. The height of the outlet of the branchpipe to the ground is 1 m ± 0,3 m and the height of the outlet of the monitor to the ground is no more than 2 m. Allow the foam discharge to fall onto a hard surface at the same elevation as the equipment and visually estimate the maximum, minimum and the point of the ground pattern where the bulk of the foam falls. Record the distances from these points to the projective point of the nozzle on the ground as the ranges at the minimum, median and maximum inlet pressures specified by the manufacturer. The distances shall be measured with the accuracy of no more than 1 m.

Test results shall meet the requirements of 4.11.

5.10 Vapour sealing test

5.10.1 The sealing elements of the foam chamber shall be installed in the suitable device and subject to an air pressure of 0,02 MPa (0,2 bar) for 10 min, increasing the pressure at a rate not more than 10 kPa/s. Test results shall meet the requirements of 4.12 a).

5.10.2 The chamber and its foam generator are to be installed in a simulated portion of a flammable or combustible storage tank or other test setup, and then be pressurized gradually to allow the foam solution to flow through the generator.

Record the inlet pressure of the foam generator necessary to break the vapour seal. Test results shall meet the requirements of 4.12 b).

5.11 Operation reliability test

Subject the spring or slider in the normal mounting to 500 cycles of normal operation (such as stretch and slide). The components shall not be operated at a rate exceeding six cycles per minute. The test results shall meet the requirements of 4.13.

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5.12 Stress corrosion test

The openings of each sample shall be filled with deionized water and sealed with a non-reactive material (e.g. plastic cap) so as to prevent the introduction of the ammonia atmosphere into the interior of the component. The samples to be tested shall be free from any non-permanent protective coating and, if necessary, shall be degreased. The samples shall be tested in their intended orientation. Samples with threads intended for the purpose of installing the product in the field shall have the threads engaged and tightened to the torque specified in Table 1. There shall be provisions in the test chamber to prevent droplets of condensation from falling from the top of the enclosure directly onto the samples. Such shield or other means shall be constructed of glass or other non-reactive materials. The samples shall be exposed to the moist ammonia-air mixture maintained in a glass chamber with a known volume. Aqueous ammonia having a density of 0,94 g/cm^3 shall be maintained in the bottom of the chamber, 40 mm to 50 mm below the bottom of the samples.

A volume of aqueous ammonia equal to 10 L/m^3 of the test chamber volume results in approximately the following atmospheric concentrations: 35 % ammonia, 5 % water vapour, and 60 % air. Prior to beginning the exposure, the chamber shall be conditioned to a temperature of 34 °C ± 2 °C for a period of not less than 1 h, and shall be maintained as such throughout the exposure period. The moist ammonia-air mixture shall be maintained at essentially atmospheric pressure. Provision shall be made for venting the chamber, such as by the use of a capillary tube, to avoid pressure build-up.

The test exposure shall be 10 d. Upon removal, samples shall be rinsed in potable water and air-dried. After a 2 d to 4 d drying period, visual examination of the samples shall be made. After exposure, the equipment shall comply with the requirement of 4.14.

Table 1 — Torque requirements for threaded connections

Nominal thread size mm	Torque N-m
3	11
6	20
10	27
13	46
19	68
25	136
32	164
38	175
50	186
64	198
76	203
102	215

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5.13 Salt-spray corrosion test

During the corrosive exposure, a metallic part is to be connected to a typical pipe fitting or hose coupling to simulate field installation, unless it is to be marked to specify fitting or coupling material or both.

The specimens shall be subjected to a salt spray using the equipment specified in ISO 9227 and a salt solution having a mass fraction of 20 % sodium chloride in distilled water. The pH of the collected salt solution shall be between 6,5 and 7,2 and the density shall be between 1,126 g/ml and 1,157 g/ml when atomized at 35 °C ± 2 °C. A suitable means of controlling the atmosphere in the chamber shall be provided.

Suspend the specimens in their normal operating position and expose them to the salt spray (fog) in a chamber having a volume of at least 0,4 m^3. Maintain the exposure zone at a temperature of 35 °C ± 2 °C. Record the temperature at least once per day. Salt solution shall be supplied from a recirculation reservoir through air-aspirating nozzles, at a pressure between 0,07 MPa (0,7 bar) and 0,17 MPa (1,7 bar). Collect salt solution

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