FINAL DRAFT UGANDA STANDARD

FDUS ISO 7165

First Edition
2009-mm-dd

Fire fighting — Portable fire extinguishers — Performance and construction

Reference number
FDUS ISO 7165:2009

Compliance with this standard does not, of itself confer immunity from legal obligations

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National foreword

Uganda National Bureau of Standards (UNBS) is a parastatal under the Ministry of Tourism, Trade and Industry established under Cap 327, of the Laws of Uganda. UNBS is mandated to co-ordinate the elaboration of standards and is

(a) a member of International Organisation for Standardisation (ISO) and

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The work of preparing Uganda Standards is carried out through Technical Committees. A Technical Committee is established to deliberate on standards in a given field or area and consists of representatives of consumers, traders, academicians, manufacturers, government and other stakeholders.

Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

This Final Draft Uganda Standard, FDUS ISO 7165 *Fire fighting — Portable fire extinguishers — Performance and construction,* is identical with and has been reproduced from an International Standard, ISO 7165:2009 *Fire fighting — Portable fire extinguishers — Performance and construction,* and is being proposed for adoption as a Uganda Standard.

This standard was developed by the Mechanical engineering and Metallurgy Standards Technical Committee (UNBS/TC 4).

Wherever the words, "International Standard" appear, they should be replaced by "Uganda Standard."

INTERNATIONAL STANDARD

ISO 7165

Second edition
2009-03-15

Fire fighting — Portable fire extinguishers — Performance and construction

Lutte contre l'incendie — Extincteurs portatifs — Performances et construction

Reference number
ISO 7165:2009(E)

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Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 7165 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 2, *Manually transportable fire extinguishers*.

This second edition cancels and replaces the first edition (ISO 7165:1999), which has been technically revised. It also incorporates the Amendments ISO 7165:1999/Amd 1:2004 and ISO 7165:1999/Amd 2:2004.

Fire fighting — Portable fire extinguishers — Performance and construction

1 Scope

This International Standard specifies the principal requirements intended to ensure the safety, reliability and performance of portable fire extinguishers.

It is applicable to a fully charged extinguisher having a maximum mass of 20 kg. Subject to local acceptance, application to extinguishers having a total mass of up to 25 kg when fully charged is permitted.

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 3130, *Wood — Determination of moisture content for physical and mechanical tests*

ISO 3941:—, *Classification of fires*

ISO 4672:1997, *Rubber and plastics hoses — Sub-ambient temperature flexibility tests*

ISO 4892-2:2006, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 5923, *Fire protection — Fire extinguishing media — Carbon dioxide*

ISO 7202, *Fire protection — Fire extinguishing media — Powder*

ISO 7203 (all parts), *Fire extinguishing media — Foam concentrates*

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

ISO 14520 (all parts), *Gaseous fire-extinguishing systems — Physical properties and system design*

3 Terms and definitions

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

3.1
batch
group of the same products made on the same production line using the same lot of materials during one production shift

3.2
bulk range
range of the extinguisher when 50 % of its media has been expelled

3.3
charge of extinguisher
mass or volume of the extinguishing medium contained in the extinguisher expressed in volume (litres) for water-based extinguishers and in mass (kilograms) for other extinguishers

3.4
classification of fires
grouping of fires on the basis of the characteristics as given in 3.4.1 to 3.4.5

See ISO 3941:—.

3.4.1
class A
involving solid materials, usually of an organic nature, in which combustion normally takes place with the formation of glowing embers

3.4.2
class B
involving liquids or liquefiable solids

3.4.3
class C
involving gases

3.4.4
class D
involving metals

3.4.5
class F
involving cooking media (vegetable or animal oils and fats) in cooking appliances

3.5
clean agent
electrically non-conductive gaseous or vapourizing liquid fire extinguishant that does not leave a residue upon evaporation

3.6
complete discharge
point in the discharge of an extinguisher when the internal pressure has equalized with the external pressure, with the valve control being kept fully open

3.7
disposable extinguisher
non-rechargeable extinguisher
extinguisher designed not to be recharged in the field or at the factory, but intended to be discarded after use

3.8
effective discharge time
time from the commencement of discharge of the extinguishing medium at the nozzle to the gas point of the discharge stream with the control valve fully open

3.9
extinguishing medium
substance contained in the extinguisher that causes extinguishment

3.10
fill density
mass in kilograms of extinguishing medium per litre of container volume as fitted for use, complete with valve and internal fittings

3.11
fire extinguisher
an appliance containing an extinguishing medium that can be discharged and directed onto a fire by the action of internal pressure; discharge may be achieved by

— stored pressure (constant pressurization of the extinguishing media container);

— cartridge operated [pressurization at the time of use by the release of a pressurizing gas stored in a separate high-pressure container (cartridge)]

3.12
gas point
point where the medium discharge changes from predominately liquid medium to predominately expellant gas

3.13
lowest observable adverse effect level
LOAEL
lowest concentration at which an adverse physiological or toxicological effect has been observed

3.14
maximum service pressure
p_{ms}
equilibrium pressure developed in a normally charged and pressurized extinguisher that is conditioned at 60 °C for at least 18 h

3.15
portable fire extinguisher
fire extinguisher that is designed to be carried and operated by hand and that, in working order, has a mass of not more than 20 kg

NOTE Subject to local acceptance, extinguishers having a total mass of up to 25 kg when fully charged are permitted.

3.16
pressure gauge
device that shows the pressure in the cylinder and the operating range of the extinguisher based on the operating temperature-pressure relationship.

NOTE The gauge face is marked with the appropriate units.

3.17
pressure indicator
device that shows that the extinguisher is pressurized at its rated expellant gas pressure

3.18
propellant
non-flammable compressed gas used to expel the extinguishing medium

3.19
rechargeable extinguisher
extinguisher designed to be recharged after use

3.20
service pressure
p_s
equilibrium pressure developed in a normally charged and pressurized extinguisher conditioned at 20 °C for at least 18 h

3.21
wet chemical
chemical agents that include, but are not limited to, aqueous solutions of potassium acetate, potassium carbonate, potassium citrate, or combinations of these materials

4 Classification of extinguishers

Extinguishers shall be classified by the type of extinguishing medium that they contain. At present, the main classes of extinguishers are

a) water-based;

b) powder;

c) carbon dioxide;

d) clean agents.

These classes of extinguishers may be further sub-divided; for example, water-based extinguishers may contain pure water or water with additives, such as wetting agents, viscosity-increasing agents, flame retardant, foaming agents, wet chemical, etc. Water-based extinguishers, including foam, containing different types of freezing-point depressants shall be treated as separate and distinct models for the fire rating tests and for the purpose of testing the range of the operating temperatures, electrical conductivity, etc. All other requirements relating to the design and construction of water-based extinguishers are applicable to all models, irrespective of contents.

5 Extinguishing media, propellants and filling requirements

5.1 Extinguishing media

5.1.1 Carbon dioxide

Carbon dioxide used in extinguishers shall comply with ISO 5923.

5.1.2 Clean agents

Clean agents used in extinguishers shall comply with the appropriate part of ISO 14520 or shall be regulated by the national environmental regulatory body of a country.

NOTE In some countries, the manufacture and use of clean agents is regulated by the Montreal Protocol or by national regulations.

5.1.3 Powders

Powders used in extinguishers shall comply with ISO 7202, with the exception of powders for use on class D fires.

5.1.4 Foam concentrates

Foam concentrates used in extinguishers shall comply with the appropriate part of ISO 7203.

NOTE There is no ISO International Standard covering non-foaming additives sometimes added to water to produce antifreeze, wetting or other special characteristics. However, such extinguishers are included in the category of water-based extinguishers.

5.1.5 Water-based agents

When the extinguishing agent has a pH exceeding 9,5, a warning statement shall be required for the extinguisher nameplate (see 10.2).

5.2 Propellants

The propellants for stored pressure and cartridge-operated extinguishers shall be air, argon, carbon dioxide, helium or nitrogen or mixtures of these gases having a maximum dew-point of −55 °C. Non-flammable tracers may be added to the propellant to facilitate leakage detection. The percentage of the tracer shall be indicated by the manufacturer and verified by the test laboratory, with the exception that it is not necessary for the propellant for stored-pressure, water-based extinguishers to meet the above dew-point.

5.3 Filling requirements

5.3.1 Fill density

The maximum fill density for carbon-dioxide extinguishers shall not exceed 0,75 kg/l. The fill density for clean agent fire extinguishers shall not exceed the values given in the appropriate part of ISO 14520.

NOTE The above fill densities can be subject to national pressure-vessel regulations.

5.3.2 Filling tolerance

The actual charge of an extinguisher shall be the nominal charge within the following limits:

a) water-based extinguisher: 0 % to 5 % by volume;

b) powder extinguishers:

   $\leqslant$ 1 kg nominal charge, $\pm$ 5 % by mass;

   $>$ 1 kg but $<$ 3 kg nominal charge, $\pm$ 3 % by mass;

   $\geqslant$ 3 kg nominal charge, $\pm$ 2 % by mass;

c) clean agent extinguishers: 0 % to 5 % by mass;

d) carbon dioxide extinguishers: 0 % to 5 % by mass.

5.3.3 Charges

The following are the recommended charges for fire extinguishers:

— water-based: 2 l, 3 l, 6 l, 9 l;

— powder: 1 kg, 2 kg, 3 kg, 4 kg, 6 kg, 9 kg, 12 kg;

— CO_2: 2,5 kg;

— clean agent: 1 kg, 2 kg, 4 kg, 6 kg.

6 Pressure requirements for low-pressure extinguishers

6.1 Test pressure

The test pressure, p_t, for low-pressure extinguishers shall be $1{,}43 \times p_{ms}$ but in no case less than 2 MPa [1] (20 bar).

6.2 Minimum burst pressure

The minimum burst pressure, p_b, for low-pressure extinguishers shall be $2{,}7 \times p_{ms}$ but in no case less than 5,5 MPa (55 bar).

7 General operating performance requirements

7.1 Operating temperatures

Extinguishers shall be capable of operating reliably within one of the following temperature ranges:

+5 °C to +60 °C;

−5 °C to +60 °C;

−10 °C to +60 °C;

−20 °C to +60 °C;

−30 °C to +60 °C;

−40 °C to +60 °C;

−55 °C to +60 °C;

The temperature range selected from the above ranges shall be marked on the fire extinguisher (see 10.2.1.5).

For water-based extinguishers without any protection against freezing, the minimum operating temperature shall be 5 °C.

7.2 Minimum effective discharge time and bulk range of discharge

7.2.1 Class A rated extinguishers

The minimum effective discharge time of extinguishers with a 1A rating shall be no less than 8 s. Extinguishers with ratings of 2A or higher shall have a minimum discharge time of 13 s.

7.2.1.1 Requirements

When three portable fire extinguishers are tested in accordance with 7.2.1.2, the duration of operation of each extinguisher shall be within ± 3 s of the average value for powder extinguishers and within 15 % of the average value for other extinguishers, but duration value shall not be less than the minimum specified.

1) 1 bar = 100 kPa = 0,1 MPa; 1 Pa = 1 N/m^2.

7.2.1.2 Test method

Carry out the testing of portable extinguishers within 5 min of removal of the extinguisher from the conditioning temperature. Store portable fire extinguishers for testing in a vertical position for at least 18 h at a temperature of 20 °C ± 5 °C before the tests are carried out and maintain the temperature within this range until tested as given below.

a) Weigh the extinguisher.

b) Hold the extinguisher in its normal working position (i.e. hand-held) and keep it immobile for the duration of the test.

c) For cartridge-operated extinguishers supplied with a final control valve and an independent activation system, pressurize with the final control valve closed. Open this final control valve 6 s after the commencement of pressurization of the extinguisher.

d) For cartridge-operated extinguishers where activation is by a simple action, pierce the cartridge and close the control valve immediately for a period of 6 s, after which reopen the control valve.

e) For extinguishers that are activated by a single operation of the control valve, open the control valve and leave open for the duration of the test.

f) Measure and record the time between the opening of the final control valve and the commencement of discharge. Measure and record the effective discharge time.

g) For gaseous extinguishers, reweigh, then calculate and record the residual charge. For all other extinguishers, reweigh, empty the residual extinguishant, then reweigh or measure and record the residual change.

All portable fire extinguishers shall operate within 4 s after the final control valve is opened.

7.2.2 Class B rated extinguishers

The minimum effective discharge time of extinguishers with a class B rating shall be no less than the appropriate value given in Table 1.

7.2.2.1 Requirements

When three portable fire extinguishers are tested in accordance with 7.2.2.2, the duration of operation of each extinguisher shall be within ± 3 s of the average value for powder extinguishers and within 15 % of the average value for other extinguishers, but duration value shall not be less than the minimum specified.

7.2.2.2 Test method

Carry out the testing of portable extinguishers within 5 min of the removal of the extinguisher from the conditioning temperature. Store portable fire extinguishers for testing in a vertical position for at least 18 h at a temperature of 20 °C ± 5 °C before the tests are carried out and maintain the temperature within this range until tested as given below.

a) Weigh the extinguisher.

b) Hold the extinguisher in its normal working position (i.e. hand-held) and keep it immobile for the duration of the test.

c) For cartridge-operated extinguishers supplied with a final control valve and an independent activation system, pressurize with the final control valve closed. Open this final control valve 6 s after the commencement of pressurization of the extinguisher.

d) For cartridge-operated extinguishers where activation is by a simple action, pierce the cartridge and close the control valve immediately for a period of 6 s, after which reopen the control valve.

e) For extinguishers that are activated by a single operation of the control valve, open the control valve and leave open for the duration of the test.

f) Measure and record the time between the opening of the final control valve and the commencement of discharge. Measure and record the effective discharge time.

g) For gaseous extinguishers, reweigh, then calculate and record the residual charge. For all other extinguishers, reweigh, empty the residual extinguishant, then reweigh or measure and record the residual change.

All portable fire extinguishers shall operate within 4 s after the final control valve is opened.

Table 1 — Minimum effective discharge time of class B rated extinguishers

Classification	Minimum discharge time s
8B [a]	—
13B [a]	—
21B	8
34B	8
55B	9
(70B)	9
89B	9
(113B)	12
144B	15
(183B)	15
233B	15
[a] This fire size is for a low-temperature fire test only.	

7.2.3 Bulk range

7.2.3.1 Requirements

The minimum bulk range of extinguishers with a class A rating shall be no less than 3 m when determined in accordance with 7.2.3.2.

7.2.3.2 Test method

Carry out the test indoors using lighting that gives the best possible illumination of the extinguisher medium during discharge. Use a black background marked to indicate the horizontal distance. Condition the extinguisher for no less than 18 h at a temperature of 20 °C $\pm$ 5 °C and place it in normal operating position with the discharge nozzle held horizontally 1 m above the floor. Fully discharge the extinguisher with the control valve fully open within 2 min of conditioning. Record the bulk range of the extinguisher as the range at the time corresponding to 50 % of the effective discharge time.

NOTE Where the range of effective discharge is difficult to determine visually, supplementary means, such as collection boxes for powders and condensing plates for liquefied gases, can also be used.

7.3 Resistance to temperature changes

7.3.1 Requirements

Portable extinguishers shall be able to operate at temperatures within one of the temperature ranges given in 7.1 as indicated by the manufacturer and shall comply with the following requirements after being subjected to the conditions given in 7.3.2.

a) The extinguisher shall operate as intended. The duration of operation shall not be less than 8 s. Carbon dioxide extinguishers, when tested at 60 °C, shall have duration of not more than the duration established at 20 °C. When tested at the minimum operating temperature, the discharge duration shall not be greater than 2,5 times the duration established at 20 °C.

b) The extinguisher shall commence discharge within 5 s of opening the control valve.

c) Powder extinguishers shall not retain more than 15 % of initial charge within the extinguisher following complete discharge. All other types shall have a maximum residue of 10 %.

7.3.2 Test method

Carry out testing on four extinguishers. Before testing, weigh each extinguisher, then subject two extinguishers to temperature cycle 1, as given in Table 2, and subject the other two extinguishers to temperature cycle 2, as given in Table 2. Store at the temperatures given in Table 2 in conditioning chambers; do not use liquid baths. Maintain extinguishers in an upright position during temperature cycling. The tolerances given in Table 2 shall be considered as nominal tolerances, with the climatic chamber empty.

Table 2 — Temperature cycles

Duration h	**Cycle 1** [a]	**Cycle 2** [a]
24 ± 1	Store at minimum [b] stated temperature (± 2 °C)	Store at (60 ± 2) °C
24 ± 1	Store at (20 ± 5) °C	Store at (20 ± 5) °C
24 ± 1	Store at (60 ± 2) °C	Store at minimum [b] stated temperature (± 2 °C)

[a] The storage temperatures refer to the ambient temperature within the conditioning chamber. A liquid bath shall not be used.

[b] See 7.1.

Operate the extinguisher within 2 min after its removal from the conditioning chamber. Hold the extinguisher in its normal working position and keep it immobile for the duration of the test.

Operate the extinguisher in accordance with 7.2.2.2.

Measure and record the time between the opening of the final control valve and the commencement of discharge. For gaseous extinguishers, reweigh, then calculate and record the residual charge. For all other extinguishers, reweigh, empty the residual extinguishant, then reweigh or measure and record the residual change.

7.4 Retention of charge

7.4.1 Routine checks

7.4.1.1 Extinguishers and gas cartridges shall be designed so as to permit their charge to be checked at regular intervals when they are installed.

7.4.1.2 The charge of the following shall be measured by weighing:

a) all types of gas cartridges for extinguishers;

b) carbon dioxide extinguishers;

c) stored-pressure extinguishers of various types, including some clean agents in which a mass loss of 1 % of total mass is accompanied by a pressure loss of not more than 10 % of the service pressure at (20 ± 2) °C.

7.4.1.3 The charge of stored-pressure extinguishers of types not covered in 7.4.1.2 b) and c) shall be checked by direct measurement of internal pressure at (20 ± 2) °C. For this purpose, the extinguisher shall be fitted with a built-in pressure-indicating device that can be checked for satisfactory operation.

A connection to which an independent pressure-measuring appliance can be attached may be used as the means for checking the built-in pressure-indicating device; in this case, a connection of this type shall be equipped with a pressure-retaining cap.

7.4.2 Retention of charge following partial discharge

7.4.2.1 Requirements

Fire extinguishers shall be fitted with a control valve allowing the discharge of the extinguishing medium to be interrupted at any time.

The extinguisher shall be adequately resistant to leakage and the second pressure (or mass of contents, as appropriate) shall be no less than 75 % of the first, after interruption of the discharge as determined in 7.4.2.2.

7.4.2.2 Test method

Carry out this test with three extinguishers conditioned for 18 h at 20 °C ± 5 °C. All three extinguishers shall pass the test.

Operate the extinguishers and allow the medium to discharge for one half of the measured discharge duration. For extinguishers with a (propellant) gas cartridge, open the control valve in accordance with a) or b), as applicable.

a) If the extinguisher is fitted with a pressurization device independent of the device that opens the control valve, operate the pressurization device and 3 min later open the control valve to initiate discharge.

b) If a single action pressurizes the extinguisher and releases the first emission of gas, pressurize the extinguisher initially and 3 min later open the control valve again to permit discharge of the extinguishing medium.

Then close the valve by the action intended to interrupt the emission of the extinguishing medium. Measure the internal pressure, or, in the case of CO_2, the mass of the extinguisher, within 10 s of, and again 5 min after, closure of the control valve, the control valve having remained closed for the duration of this period.

7.4.3 Long-term leakage test

7.4.3.1 Requirements for stored-pressure extinguishers

Stored-pressure extinguishers covered by 7.4.1.3 shall not leak at a rate exceeding 5 % per annum of service pressure.

7.4.3.2 Requirements for gas cartridges and extinguishers checked by mass

Long-term leakage requirements are as follows.

— Stored-pressure extinguishers without a pressure gauge shall not leak at a rate exceeding 5 %/yr or 50 g/yr of its contents, whichever is less [see 7.4.1.2 c)].

— Gas cartridges shall not leak at a rate exceeding 5 %/yr or 7 g/yr of its contents, whichever is less.

— Carbon dioxide extinguishers shall not leak at a rate exceeding 5 %/yr.

7.4.3.3 Test method

Check six samples for leakage after 30 d, 90 d and 120 d. Any loss in pressure or contents at constant ambient temperature is an indication of a leak.

7.5 Mechanical resistance

7.5.1 Resistance to impact

NOTE This test is intended to prove the resistance of the extinguisher, and particularly that of the head and fittings, to damage from falling objects or from impact with fixed surfaces.

7.5.1.1 Requirements

The extinguisher shall not release pressure in a potentially dangerous manner when tested in accordance with 7.5.1.2.

The portable extinguishers shall be judged fit and proper if, during the course of the impact tests, there is no evidence of bursting, breakage or ejection of components that puts the safety of the user at risk.

7.5.1.2 Test method

Carry out the test on two charged, portable fire extinguishers. Test one extinguisher horizontally and the other vertically. Condition the extinguishers, correctly charged and equipped with all the fittings that are subject to internal pressure in normal operation, for 18 h to the minimum working temperature $\pm$ 2 °C (see 7.1). Within 2 min after the removal of the extinguisher from the conditioning chamber, subject it to the impact test described below.

For the purpose of this test, an anti-freeze agent is added to prevent freezing of the contents of water-based extinguishers. Carbon dioxide extinguishers shall be filled to 95 % of volume with water or water plus anti-freeze agent and pressurized with nitrogen to the working pressure that would exist at the test temperature if the extinguisher were charged with CO_2.

If the extinguisher is a gas-cartridge type, fit the charged cartridge and activate the extinguisher with the control valve shut, so as to keep the extinguisher under pressure.

Conduct the impact test as follows.

a) Mount a steel cylindrical hammer, of 75 mm diameter and total mass of 4,0 kg with flat faces, vertically in loose guides so that it can drop freely through a height, h, expressed in metres, of not less than 0,3 m (minimum height 300 mm) as given by Equation (1):

$$h = \frac{m}{20} \tag{1}$$

where m is the total mass of extinguisher, expressed in kilograms.

b) Place the extinguisher on a rigid flat surface in each of the following two positions in turn:

— in the normal upright position, with the longitudinal axis of the hammer coincident with the longitudinal axis of the valve;

— lying on its side so that the hammer impacts the valve through the centreline of the extinguisher and the valve rests on a rigidly fixed steel block; the centreline of the hammer shall not be coincident with the longitudinal axis of the extinguisher and shall not impact the cylinder.

c) In each of the above positions, submit the valve of the extinguisher to an impact by allowing the steel hammer to fall vertically onto it from the height, h. The point of impact is determined by the authority carrying out the test.

7.5.2 Resistance to vibrations

7.5.2.1 Test principle

An extinguisher shall be capable of withstanding exposure to the conditions of a vibration test without development of physical weakness that would impair its normal operation.

7.5.2.2 Extinguisher mounting requirements

Extinguishers not intended for use in vehicles shall be subjected to the test specified in 7.5.2.5.2.

Extinguishers supplied with a bracket for use in vehicles shall be subjected to the test specified in 7.5.2.5.3.

Extinguishers supplied with a bracket suitable for both general and vehicle use shall be subjected to the test specified in 7.5.2.5.3.

7.5.2.3 Test criteria

The test criteria are as follows.

a) Following exposure to the vibration test, the extinguisher shall comply with the discharge requirements specified in 7.2.

b) Physical failure of components that requires repair or replacement of the extinguisher and/or components before it can be returned to normal service shall be cause for rejection.

7.5.2.4 Mounting of the test specimen

Mount a fully charged extinguisher in an upright position. Mount extinguishers intended for use in vehicles in their intended bracket. Extinguishers not intended for use in vehicles may be tested without a bracket.

7.5.2.5 Test orientation

7.5.2.5.1 Axes of orientation

Subject the extinguisher to the vibration test specified in 7.5.2.5.2 or 7.5.2.5.3 in each of the three rectilinear axes in the following order: horizontal, lateral and vertical.

7.5.2.5.2 General extinguishers

The vibration applied shall have the following characteristics:

— frequency: 40 Hz;

— amplitude: 0,25 mm ± 0,03 mm;

— duration: 2 h (in each orientation specified in 7.5.2.5.1).

7.5.2.5.3 Vehicle extinguishers

Subject the vehicle extinguishers to the following tests.

a) Subject the extinguisher to the variable frequency and amplitude specified below in each orientation specified in 7.5.2.5.1:

   — frequency: 10 Hz to 19 Hz, amplitude: 0,75 mm ± 0,08 mm;

   — frequency: 20 Hz to 39 Hz, amplitude: 0,50 mm ± 0,05 mm;

   — frequency: 40 Hz to 60 Hz, amplitude: 0,25 mm ± 0,03 mm.

   Vibrate the extinguisher for 5 min at each frequency and increase the frequency at discrete intervals of 2 Hz.

b) Vibrate the extinguisher for 2 h at the frequency that produced the maximum resonance as determined in a) above or, if no resonance is observed, subject the extinguisher to the test specified in 7.5.2.5.2.

Complete the tests specified in a) and b) above in one plane before making tests in the next plane.

7.6 Resistance to corrosion

7.6.1 External corrosion test

Subject complete and fully charged extinguishers, including their mounting bracket and wall hook, to a salt spray test in accordance with the neutral salt spray test (NSS) as defined in ISO 9227, for a period of 480 h. Carefully wash the extinguisher to remove any salt deposits and let it dry for 24 h. Test two samples, either two of the same size or one sample each of two different sizes from the same family.

At the conclusion of the test, the following requirements shall be satisfied.

— The mechanical operation of all working parts shall be unimpaired; the force required to release the safety device shall be as specified in 9.11.1.

— The minimum effective discharge time and method of operation shall comply with requirements specified in 7.2 and 9.10.

— The pressure gauge, if one is fitted, shall remain functional and watertight. It shall conform to 9.12.2 and 9.12.7.

— There shall be no corrosion of the metal of the extinguisher body; discoloration or superficial corrosion of non-ferrous metals is acceptable, but galvanic corrosion between dissimilar metals shall not be permitted.

— When tested in accordance with 9.9.3, the burst pressure of the hose shall be as specified. The test shall be carried out at 20 ± 5 °C.

7.6.2 Internal corrosion test for extinguishers using water-based media

Subject two extinguishers, charged in accordance with the manufacturer's filling instructions, eight times to the temperature cycle defined in Table 3.

Table 3 — Temperature cycle

Stage	Duration h	Temperature [a] °C
1	24 ± 1	[b]
2	⩾ 24	20 ± 5
3	24 ± 1	60 ± 2
4	⩾ 24	20 ± 5

[a] The temperature refers to the ambient temperature of the conditioning chamber. A liquid bath shall not be used. The duration of any one complete cycle shall not exceed 120 h.

[b] The lowest temperature marked on the extinguisher ± 2 °C. See 7.1.

On completion of the eight temperature cycles, cut each body into two sections in a manner sufficient to permit internal examination. Disregard detachment of any protective coating local to the plane of section. There shall be no visible signs of corrosion of the metal nor detachment, cracking or bubbling of any protective coating. There shall be no visible change in the colour of the extinguishing media other than that resulting from the thermal cycling.

Allowance should be made for a change of colour that occurs naturally due to the temperature changes. It is recommended that two samples of the agent be stored in closed glass containers and one subjected to the same cycles as the extinguishers in order to establish a reference sample.

7.7 **Tapping test** (powder extinguishers only)

7.7.1 Requirements

Portable extinguishers shall comply with the following requirements after being subjected to the conditioning specified in 7.7.3; they shall

a) operate satisfactorily;

b) commence discharge within 5 s of the opening of the control valve;

c) not retain more than 15 % of initial charge within the extinguisher following complete discharge (complete extinguisher discharge includes the medium and propellant).

7.7.2 Test apparatus

The test apparatus shall consist of a compaction machine, designed to accept only one extinguisher at a time, which shall be raised by a rod and guided by castors.

The plate supporting the extinguisher shall be steel (300 ± 5) mm square and (60 ± 1) mm thick. Figure 1 is an example of an acceptable test apparatus.

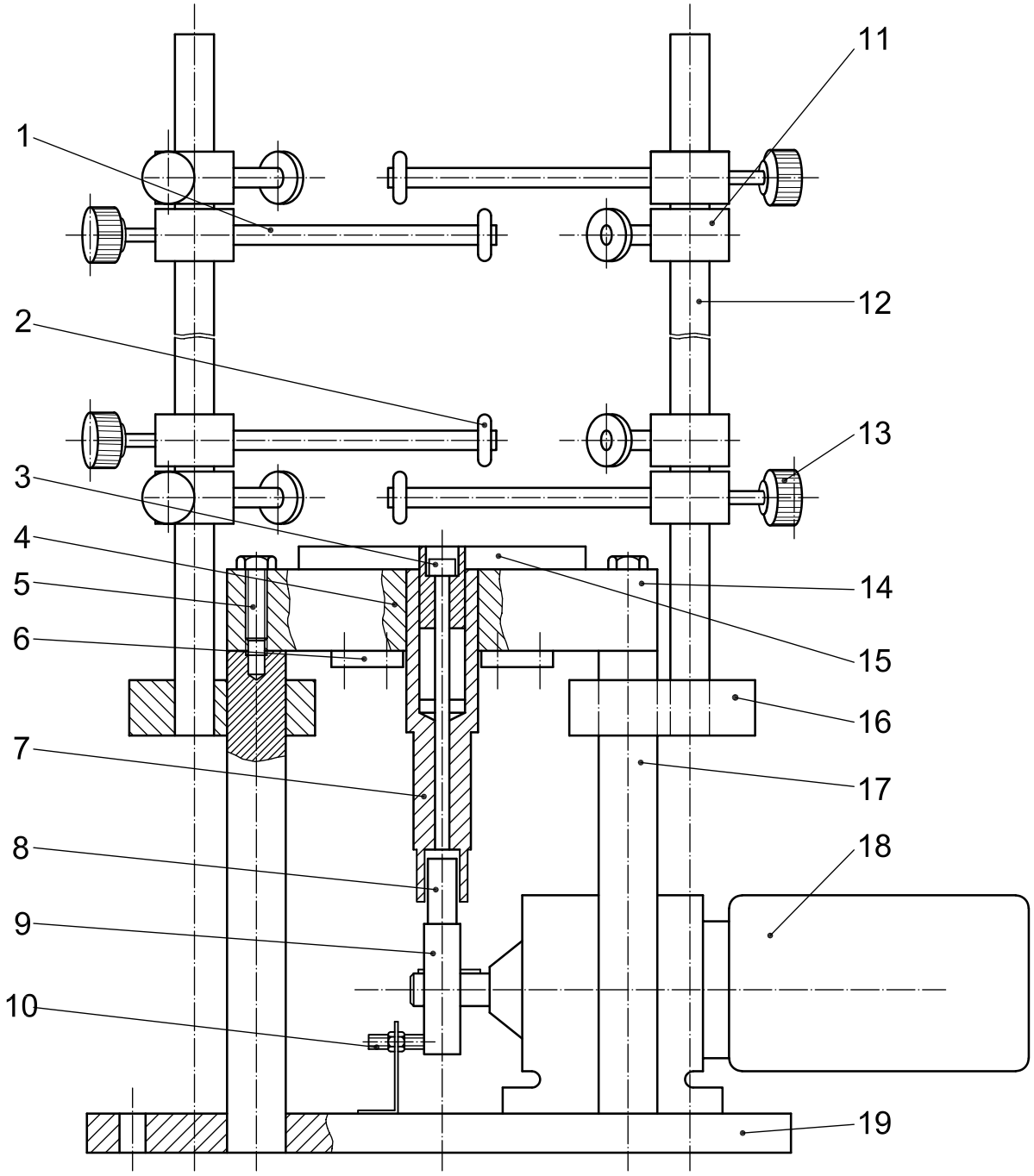
Observe the following points.

— Ensure that the rod is adjustable so as to adjust to the extinguisher base.

— Ensure that the rod can move freely in the guide castors.

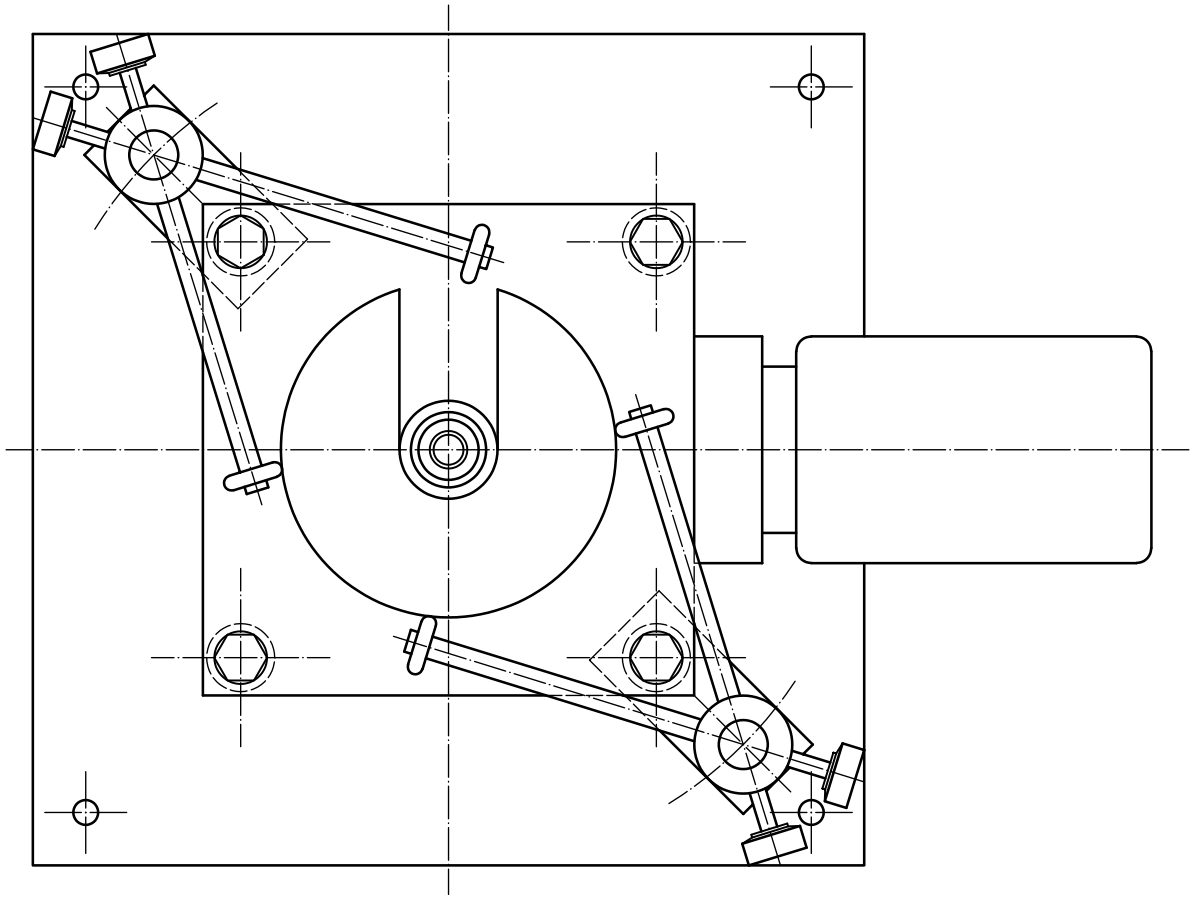
— The extinguisher shall be guided without constraint.

— The impact shall take place on the steel plate and not on the rod.



a) General diagram

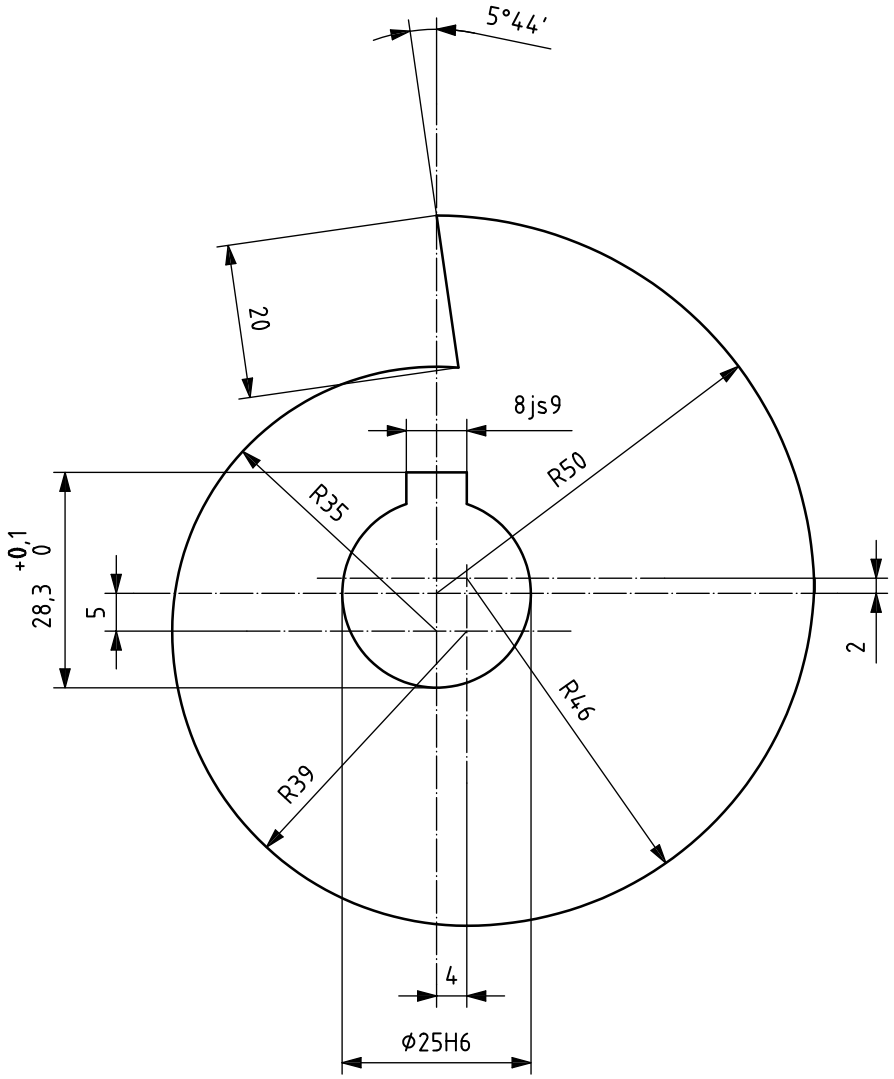
Figure 1 (*continued*)



b) View from above

Figure 1 (*continued*)

Dimensions in millimetres



c) Details of cam, key item No. 9 in Figure 1 a)

Key

1 castor support axis
2 castors
3 CI+C, M12-190 screw
4 push-nut extinguisher
5 H, M16-90 screw
6 plates
7 piston
8 castor
9 cam, 20 mm thick
10 inductive pick-up
11 rotation guidance
12 axes
13 castor nut
14 support plate
15 adjusting block
16 support axes
17 plate support axis
18 Flender-Himmel geared motor
19 system support plate

Figure 1 — Tapping machine

7.7.3 Test method

Unless otherwise specified for this particular test, carry out the testing at a temperature of 20 °C ± 5 °C.

Store portable fire extinguishers for testing for at least 18 h at a temperature of 20 °C ± 5 °C before the tests are carried out and maintain the temperature within this range until tested.

Hold a normally charged extinguisher in the vertical position and drop it vertically 500 times from a height of 15 mm at a frequency of 1 Hz onto a rigid horizontal steel plate.

Remove the extinguisher from the test apparatus with a minimum amount of agitation, hold it in its normal working position and operate it.

For cartridge extinguishers, pierce the cartridge and allow the pressure to build for 6 s before opening the control valve.

7.8 Intermittent discharge test

7.8.1 An extinguisher conditioned at (20 ± 5) °C and at (60 ± 2) °C shall operate in such a manner that for the first discharge, not more than 5 s elapse from the time the control valve is opened until the extinguishing medium starts to discharge and 1 s for the other discharges. Additionally, at the end of discharge, the extinguisher shall not retain more than the following percentages of its original charge:

— powder: 15 %;

— all others: 10 %.

Carry out testing on four extinguishers. Before testing, weigh each extinguisher, then condition two extinguishers at (20 ± 5) °C and the other two extinguishers at (60 ± 2) °C. Store at the temperatures specified in a conditioning chamber. Do not use a liquid bath. Extinguishers shall remain upright during temperature conditioning. The tolerances given shall be considered nominal tolerances, with the climatic chamber empty.

Operate the extinguisher within 2 min of its removal from the conditioning chamber in accordance with 7.8.2. For cartridge-type extinguishers where activation is by a single action, pierce the cartridge and close the control valve immediately for a period of 6 s, after which reopen the control valve. For cartridge-operated extinguishers with a final control valve and an independent activation system, pressurize with the final control valve closed. Open this final control valve 6 s after the commencement of pressurization of the extinguisher.

Measure and record the time between the opening of the final control valve and the commencement of discharge. Reweigh the extinguisher and record the residual charge. All four extinguishers shall pass the test.

7.8.2 Condition a correctly charged extinguisher at each of the specified temperatures for a minimum of 18 h. Operate the extinguisher intermittently by opening and closing the valve in cycles of 2 s “open” and 2 s “closed” until the end of discharge is reached.

7.8.3 For cartridge-operated extinguishers, pierce the cartridge and allow the pressure to build for 6 s before opening the control valve.

8 Performance requirements for test fires

8.1 Rating suitability for the various classes of fire

8.1.1 Class A

The rating of extinguishers recommended as suitable for class A fires shall be determined using the method described in 8.3. The rating shall be based on the amount of extinguishing medium used to extinguish a fire of maximum size under the conditions of the test. This amount shall be no less than the appropriate minimum value given in Table 4.

Table 4 — Amount of extinguishing medium used to obtain a minimum class A rating of extinguishers

Extinguishing medium content (charge)			Minimum class A rating
Powder kg	Water/foam Water with additives l	Clean agent kg	
$\leqslant 2$	$\leqslant 6$	$\leqslant 6$	1A
$> 2, \leqslant 4$	$> 6, \leqslant 10$	$> 6, \leqslant 8$	2A
$> 4, \leqslant 6$	> 10	> 8	3A
$> 6, \leqslant 9$			4A
> 9			6A

8.1.2 Class B

The rating of extinguishers recommended as suitable for class B fires shall be determined using the method given in 8.4. An alternate method for powder extinguishers is given in Annex A. The rating shall be based on the amount of extinguishing medium used to extinguish a fire of maximum size under the conditions of the test. This amount shall be no less than the appropriate minimum value given in Table 5.

Table 5 — Amount of extinguishing medium used to obtain a minimum class B rating of extinguishers

Extinguishing medium content (charge)				Minimum class B rating
Powder kg	Carbon dioxide kg	Clean agent kg	Foam or water with additives l	
$\leqslant 2$	$\leqslant 2$	$\leqslant 2$	—	21B
$> 2, < 3$	$> 2, < 5$	$> 2, \leqslant 4$	< 3	34B
$\geqslant 3, \leqslant 4$	$\geqslant 5$	$> 4, \leqslant 6$	$\geqslant 3, \leqslant 6$	55B
$> 4, \leqslant 6$	—	> 6	$> 6, \leqslant 9$	89B
> 6	—	—	> 9	144B

8.1.3 Class C

There are no test requirements for the performance of extinguishers against class C fires included in this International Standard. Suitability for use against class C may be claimed for class B or class AB powder extinguishers only.

8.1.4 Class D

Extinguishers recommended as suitable for class D fires shall extinguish the appropriate test fire or fires when tested as described in 8.5.

NOTE Extinguishers suitable for class D fires are usually not suitable for use on fires of other classes. Specialized media and applicators are typically used.

8.1.5 Class F

Extinguishers recommended as suitable for class F fires shall extinguish the appropriate test fires as described in 8.7 and pass the splash test requirements as described in 8.8. In addition, wet-chemical type extinguishers shall meet the requirements of 8.6.

8.2 Test fires — General

8.2.1 Operator's clothing

To carry out these tests, the operator shall wear suitable working clothing.

IMPORTANT — Attention is drawn to the necessity for taking precautions to safeguard the health and safety of personnel conducting the tests against the risk of fire and inhalation of smoke and any toxic products of combustion, and for compliance with any national legislation that can apply concerning the health and safety of the extinguisher operator and other personnel.

WARNING — Respiratory protection may be worn to protect the operator from effects of the repeated testing over a period of time. Such protection is not intended to permit an otherwise intolerable exposure to any fumes and/or smoke from a single fire.

WARNING — Suitable working clothing should not be liable to ignite or melt during the fire fighting process and may include a safety helmet with heat-resistant face guard (visor), a long coat or overalls, and gloves of aluminized, insulated cloth.

8.2.2 Requirements for extinguishment

Test fires shall be regarded as extinguished if

— for class A, all flames are extinguished. There shall be no flames visible 10 min after complete discharge of the extinguisher. The appearance of non-persistent flames during the 10 min period shall be ignored. Non-persistent flames are defined as being less than 50 mm high and of less than 1 min duration;

— for class B, all flames are extinguished and there remains a minimum heptane depth of 5 mm at any point in the tray;

— for class F, all flames are completely extinguished. There shall be no re-ignition of the vegetable oil for 20 min after discharge or until the temperature decreases to at least 35 °C below the auto-ignition temperature, whichever is longer.

If the class A crib collapses during the test, it shall be considered void and a fresh test carried out.

8.2.3 Test extinguishers and method of use

Use extinguishers filled and charged according to the manufacturer’s instructions. Store the extinguishers for at least 24 h at a temperature of (20 ± 5) °C and maintain this temperature until tested. Before testing, except the low-temperature test specified in 8.4.5, powder extinguishers shall be subjected to the tapping test.

Use the extinguishers according to the manufacturer’s operating instructions.

It is permitted, at the operator's discretion, to operate a gas-cartridge extinguisher so as to allow the operating pressure to increase in the body prior to discharge.

8.2.4 Test schedule

The basic schedule of testing is a set of three fires. A class A, class B or class F rating is achieved by extinguishing two out of three fires of the same size. Class D suitability for a particular metal or form of metal is established by extinguishing either the first fire of the set or, if this is not extinguished, extinguishing the second and third test fires.

A set is comprised of fires carried out consecutively, and the result of any particular test fire shall not be disregarded. Each set shall be completed before another is started. For class A, class B and class F fires, a set is complete either when all three test fires are carried out or when the first two test fires are both successful or both unsuccessful. For class D fires, a set is complete when the first test is successful, or when the first and second fires are both unsuccessful, or when all three are carried out.

Water-based models that can be produced with or without an anti-freeze agent shall be treated as separate and distinct models for the fire rating test.

8.3 Class A test fire

8.3.1 Location

Conduct the tests in an essentially draught-free room having adequate volume and ventilation to ensure the necessary supply of oxygen and reasonable visibility for the period of the test.

Air inlet openings at or near ground level as given in Table 6, with a flue area of 4,5 m^2, have been found to provide adequate ventilation.

For example, it has been established that a room having a ceiling height of approximately 7,5 m and a volume of at least 1 700 m^3 with adjustable inlet openings near the four corners is suitable for these purposes. The room should have a smoothly finished concrete floor.

Table 6 — Example of typical air-inlet sizes for ventilation of class A test fires

Classification and rating	Air-inlet opening surface area m^2
1A	0,10
2A	0,10
3A	0,15
4A	0,20
6A	0,30
10A	0,50
15A	0,75
20A	1,00

8.3.2 Construction

The test fire consists of a crib made of pieces of wood. The pieces of wood forming the outside edges of the crib may be stapled or nailed together to provide strength. Construct the crib on two 63 mm × 38 mm angle irons or other similar and appropriate supports placed on concrete blocks or a support frame so that the height of the supports above the floor is (400 ± 10) mm.

Stack the pieces of wood in the appropriate arrangement specified in Table 7. Stack each layer of the pieces of wood at right angles to the layer below. Stack individual pieces of wood on each layer with even spacing and in the form of a square with sides equal to the length of the piece of wood (see Figure 2).

Use pieces of wood of *Pinus sylvestris*, or of other wood that can be shown to be equivalent, of appropriate length as specified in Table 7 and of square cross-section with sides of (39 ± 1) mm and a moisture content of 10 % to 14 % by mass (dry basis).

A wood is considered to be equivalent if the rating achieved using the wood is not more than that achieved when *Pinus sylvestris* is used. In North America, mixed spruce-pine-fir lumber, which can include *Picea glauca*, *Picea engelmannii*, *Pinus contorta* and *Abies lasioscapa*, or *Pinus banksiana*, *Picea rubens*, *Picea maraina* and *Abies balsamea* depending on geographical location, may be used. *Cryptomeria japonica* may be preferred in parts of Asia.

Determine the moisture content of the pieces of wood using commercially available instruments that measure electrical conductivity between needle probes pushed into the sticks or other suitable method. Some variation in reading can be obtained due to structural variation of the timber and the direction of the grain. Calibrate the instrument by a determination of the moisture content in accordance with ISO 3130.

8.3.3 Procedure

Place an ignition pan of appropriate size as specified in Table 8 on the floor under the crib. Level the pan as far as is possible and add sufficient water to cover the base. Pour the appropriate volume of fuel (as specified in Table 8) into the pan. Ignite the fuel.

Allow the crib to burn until its mass is reduced to (55 ± 2) % of its original mass.

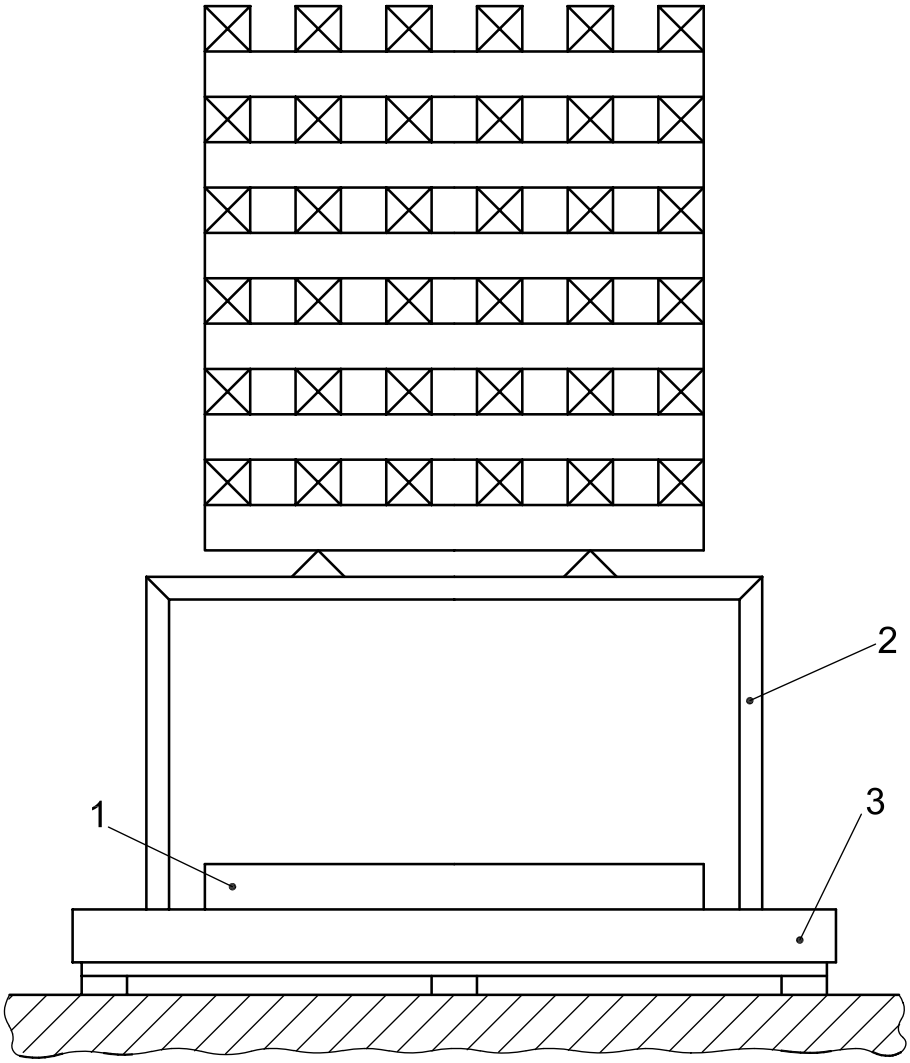
Apply the discharge of the extinguisher to the test fire, initially to the front and from a distance of not less than 1,8 m. Reduce the distance of attack and apply the discharge to the top, bottom, front or either side but not the back of the crib, at will. Maintain all devices for controlling the flow of the extinguishing medium in the position for maximum discharge to ensure a continuous jet.

Table 7 — Wood crib construction

Class A rating	Number of pieces of wood	Length of pieces of wood mm	Arrangement of pieces of wood
1A	72	500	12 layers of 6 pieces of wood
2A	112	635	16 layers of 7 pieces of wood
3A	144	735	18 layers of 8 pieces of wood
4A	180	800	20 layers of 9 pieces of wood
6A	230	925	23 layers of 10 pieces of wood
10A	324	1 100	27 layers of 12 pieces of wood
15A	450	1 190	30 layers of 15 pieces of wood
20A	561	1 270	33 layers of 17 pieces of wood
NOTE If necessary in the future, it is intended that this table be extended to include larger test fires. These will be constructed on the same principles as those now listed. Each class A rating is designated by a number in a series that is proportional to the mass of wood contained in a crib, i.e. a 20A crib contains twice the mass of wood as in a 10A crib. All cribs are cubic with the volume of the open space approximately equal to the volume of the wood.			

Table 8 — Wood crib ignition arrangement

Class A rating	Ignition pan size mm	Heptane charge [a]
1A	400 × 400 × 100	1,1
2A	535 × 535 × 100	2,0
3A	635 × 635 × 100	2,8
4A	700 × 700 × 100	3,4
6A	825 × 825 × 100	4,8
10A	1 000 × 1 000 × 100	7,0
15A	1 090 × 1 090 × 100	7,6
20A	1 170 × 1 170 × 100	8,2
[a] See 8.4.3.		



Key

1 ignition pan
2 support frame
3 weighing platform

Figure 2 — Crib fire

8.4 Class B test fire

8.4.1 Location

Carry out test fires up to and including 144B indoors. Carry out test fires larger than 144B indoors or outdoors but with the wind speed not exceeding 3 m/s. Do not carry out tests outdoors when rain, snow or hail is falling.

8.4.2 Construction

Class B test fires utilize a range of welded-sheet-steel cylindrical trays (dimensions given in Table 9). The sides are vertical. The base of the tray is set horizontal and level with the surrounding ground.

NOTE Reinforcement of the base of the larger test fire trays is necessary to minimize distortion. In such cases, it is necessary to ensure that the underside of the tray is not exposed to the atmosphere.

Details of class B test fires are given in Table 9. Each test fire is designated by a number followed by the letter B.

8.4.3 Fuel

Use an aliphatic hydrocarbon having an initial boiling point of no less than 84 °C and a final boiling point of no more than 105 °C, with a difference between initial and final points of distillation of $\leqslant$ 10 °C, an aromatic volume fraction of $\leqslant$ 1 % and a density at 15 °C of 0,680 to 0,720.

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

Table 9 — Dimensions of class B test fires [f]

Classification	Minimum discharge of extinguisher	Volume of liquid [a, g]	Dimensions of test fire tray			
			Diameter [b]	Internal depth [b, e]	Minimal thickness of walls and base	Approximate surface area of fire [d]
	s	l	mm	mm	mm	m^2
8B [c]	—	8	570 ± 10	150 ± 5	2,0	0,25
13B [c]	—	13	720 ± 10	150 ± 5	2,0	0,41
21B	8	21	920 ± 10	150 ± 5	2,0	0,66
34B	8	34	1 170 ± 10	150 ± 5	2,5	1,07
55B	9	55	1 480 ± 15	150 ± 5	2,5	1,73
(70B)	9	70	(1 670 ± 15)	(150 ± 5)	(2,5)	(2,20)
89B	9	89	1 890 ± 20	200 ± 5	2,5	2,80
(113B)	12	113	2 130 ± 20	(200 ± 5)	(2,5)	(3,55)
144B	15	144	2 400 ± 25	200 ± 5	2,5	4,52
(183B)	15	183	2 710 ± 25	(200 ± 5)	(2,5)	(5,75)
233B	15	233	3 000 ± 30	200 ± 5	2,5	7,32

NOTE Each test fire is designated by a number in a series in which each term is equal to the sum of the two preceding terms (this series is equivalent to geometric progression having a common ratio of about 1,62). Test fires larger than those given can be constructed following the rules of this geometric progression. The additional fires 70B/113B/183B represent the product of the preceding term and $\sqrt{1{,}62}$.

[a] 1/3 water and 2/3 heptane.

[b] Measured at rim.

[c] This fire size is for a low-temperature fire test only.

[d] The surface area of the tray, in square decimetres, is equal to the product of the test fire size and π.

[e] The minimum height from the surface of the fuel to the rim of the tray shall be 100 mm for fires up to and including 70B and 140 mm for fires of larger sizes.

[f] The height from the ground to the rim of the tray shall not exceed 350 mm. The construction of the tray shall prevent the flow of air under the tray, or sand or earth shall be built around the tray up to, but not above, the level of the base.

[g] After each test, a minimum of 5 mm of fuel shall remain.

8.4.4 Procedure

8.4.4.1 Add the appropriate volume of water and heptane specified in Table 9. Add additional water to compensate for distortion of the base so that all points are covered, subject to a maximum liquid depth of 50 mm and a minimum heptane depth of 15 mm at any point.

8.4.4.2 For water-based and clean agent extinguishers, use fresh fuel and water for each test.

For CO_2-type extinguishers and powder-type extinguishers, when a test fire using a tray filled with fresh fuel and water has been successfully extinguished with the tested extinguisher, then add the fuel once for the next test.

8.4.4.3 When testing powder extinguishers, it shall be demonstrable that the rating can be achieved using fresh fuel.

8.4.4.4 Ignite the fuel.

8.4.4.5 Permit the fuel to burn freely for a minimum of 60 s before operating the extinguisher.

For cartridge-operated extinguishers, the operator shall pierce the cartridge and allow the pressure to build for at least 6 s prior to the end of the 60 s pre-burn.

8.4.4.6 The operator shall then bring the extinguisher into use, within no more than 10 s after the 60 s pre-burn period, and direct the jet onto the test fire.

The extinguisher may be discharged continuously or in intermittent bursts at the discretion of the operator. The operator may move round the fire in order to obtain the best results.

CAUTION — For reasons of safety, the operator shall not reach over the edge of the tray, and at no time shall the operator step onto or into the tray.

The operator shall indicate when the extinguisher is fully discharged or when the fire is extinguished.

8.4.5 Low-temperature extinguishing test

An extinguisher, charged to its rated capacity with extinguishing agent and expellant gas and conditioned at the minimum storage temperature for 18 h, shall extinguish a class B test fire two classification sizes smaller than the rating of the extinguisher given in Table 9.

Before testing, weigh the extinguisher, then condition the extinguisher at the minimum operating temperature (± 2 °C) for a period of 18 h. Store at the specified temperature in a conditioning chamber. Do not use a liquid bath. Maintain the extinguisher in an upright position during temperature conditioning. The tolerances (± 2 °C) shall be considered nominal tolerances, with the climatic chamber empty.

Carry out the test within 5 min of removal of the extinguisher from the conditioning chamber. For cartridge-operated extinguishers, the operator shall pierce the cartridge and allow the pressure to build for at least 6 s prior to the end of the 60 s pre-burn period. The operator shall then bring the extinguisher into use within no more than 10 s after the 60 s pre-burn period and direct the jet onto the test fire.

8.5 Class D test fire

8.5.1 General

Extinguishing these test fires is based on the use of a portable extinguisher having a nominal charge of 13,6 kg of medium. Extinguishers having a lesser charge shall be tested using a proportionally reduced quantity and surface area of fuel. Extinguishers with a charge of less than 8 kg shall not be allowed.

WARNING — Some extinguishing media used for class D fires are toxic (for example, barium chloride $BaCl_2$) and/or can react with the burning metal to produce materials that are toxic or otherwise hazardous (for example, phosphates, which react to form metal phosphides that are decomposed by water to produce phosphine, PH_3, a spontaneously flammable gas).

Before carrying out these tests, establish procedures to protect personnel and to safely dispose of residues from test fires.

Conduct the tests in an essentially draught-free room having adequate volume and ventilation to ensure the necessary visibility for the period of the test.

There are no numerical components for class D ratings. The type of combustible metal for which the extinguisher is applicable and the area, depth and other characteristics of the fires that can be controlled and

extinguished are to be summarized on the extinguisher nameplate and described in the manufacturer's installation instructions.

8.5.2 Metal chip or turning fires

8.5.2.1 Construction

The fires consist of a bed of the metal fuel, 600 mm × 600 mm square, positioned centrally on a steel baseplate 1 m × 1 m square and 5 mm thick. Use a removable metal or wood frame (600 mm × 600 mm × 300 mm) to build the bed.

For ignition, use a device such as a gas/oxygen torch that can ignite the metal within 30 s.

8.5.2.2 Fuel

Carry out four series of tests using

a) magnesium alloy;

b) magnesium alloy with cutting oil;

c) reagent-grade magnesium;

d) reagent-grade magnesium with cutting oil.

The magnesium alloy shall contain (8,5 ± 1) % of aluminium and, at maximum, 2,5 % zinc, and the nominal particle size shall be 10 mm to 25 mm long, 6 mm to 13 mm wide and 0,05 mm thick.

The reagent-grade magnesium shall contain no less than 99,5 % magnesium and the nominal particle size shall be 6 mm to 9 mm long, 3 mm wide and 0,25 mm thick.

For the tests without cutting oil, use (18,0 ± 0,1) kg of metal for each fire. For the tests with cutting oil, use (16,2 ± 0,1) kg metal evenly coated with (1,8 ± 0,1) kg of a petroleum-based cutting oil with a relative density of (0,86 ± 0,01) having a Cleveland open-cup flashpoint value of (146 ± 5) °C for each fire.

8.5.2.3 Procedure

For each test, prepare the fuel bed in the removable metal or wood frame. Level the surface of the fuel using a rake or straight-edged board. Remove the frame.

Apply the igniting torch to the centre of the fuel bed, removing the torch after 25 s to 30 s.

Allow the fire to spread until it is estimated that either 25 % of the fuel is burning or the fire covers 50 % of the fuel bed surface, whichever occurs sooner. The extinguisher may then be discharged onto the fire at the operator's discretion, continuously or intermittently, according to the manufacturer's instructions.

Check that fuel is not scattered off the baseplate during the attack.

After discharge is complete, allow the fire bed to remain undisturbed for the period of time recommended by the extinguisher manufacturer or for 60 min if no time is recommended. Examine the fuel bed and check that the fire is completely extinguished and that more than 10 % mass of the original metal fuel remains.

8.5.3 Metal powder or dust fires

8.5.3.1 Construction

Construct the fires in the same manner as the metal chip fires (see 8.5.2.1).

8.5.3.2 Fuel

Use magnesium powder containing not less than 99,5 % magnesium. All the particles shall pass a 387 µm sieve and no less than 80 % of the powder shall be retained on a 150 µm sieve. Carry out two series of tests: one series using (11,0 ± 0,1) kg of dry metal and one series using (9,9 ± 0,1) kg of the metal plus (1,1 ± 0,1) kg of the oil specified in 8.5.2.2 for each fire.

8.5.3.3 Procedure

Carry out the tests using the same procedure as the metal chip fires in 8.5.2.3.

8.5.4 Shallow liquid metal fires

8.5.4.1 Construction

Carry out two series of tests. One series is carried out in a circular steel pan approximately 540 mm in diameter and (150 ± 10) mm deep, fitted with a tight-fitting cover, and with a suitable means of handling, moving and tipping, and with a horizontal thermocouple positioned in the approximate centre of the pan. This pan is also used to melt the metal fuel, using a heat source that does not allow any flames to extend beyond the base of the pan. In the second series, melted burning fuel is poured on a tray approximately 600 mm × 600 mm square and having a depth of (155 ± 5) mm.

8.5.4.2 Fuel

Use commercial sodium: for the spill fire, (1,36 ± 0,04) kg of sodium; and for the pan fire, sufficient sodium to give a melted fuel depth of (25 ± 1) mm.

8.5.4.3 Procedure

8.5.4.3.1 Spill fire

Position the square tray on a flat, level surface. Heat the metal in the covered melting pan until the temperature is (520 ± 10) °C. Carefully remove the cover, allowing the liquid metal to ignite as air enters. Stop heating when the temperature reaches (550 ± 10) °C and pour the burning liquid fuel into the square tray. As soon as the burning fuel has spread across the tray, the fire can be attacked at the operator's discretion using the manufacturer's recommended extinguishing techniques.

After the discharge is complete, allow the fire tray to remain undisturbed for the period of time recommended by the manufacturer, or for (4 ± 0,5) h if no time is recommended. Then, using a suitable temperature-measuring device, check that the fuel/extinguishing medium mixture in the tray is at a temperature no more than 20 °C above the ambient air temperature and that more than 10 % mass of the original fuel remains.

8.5.4.3.2 Pan fire

This test is carried out entirely in the melting pan.

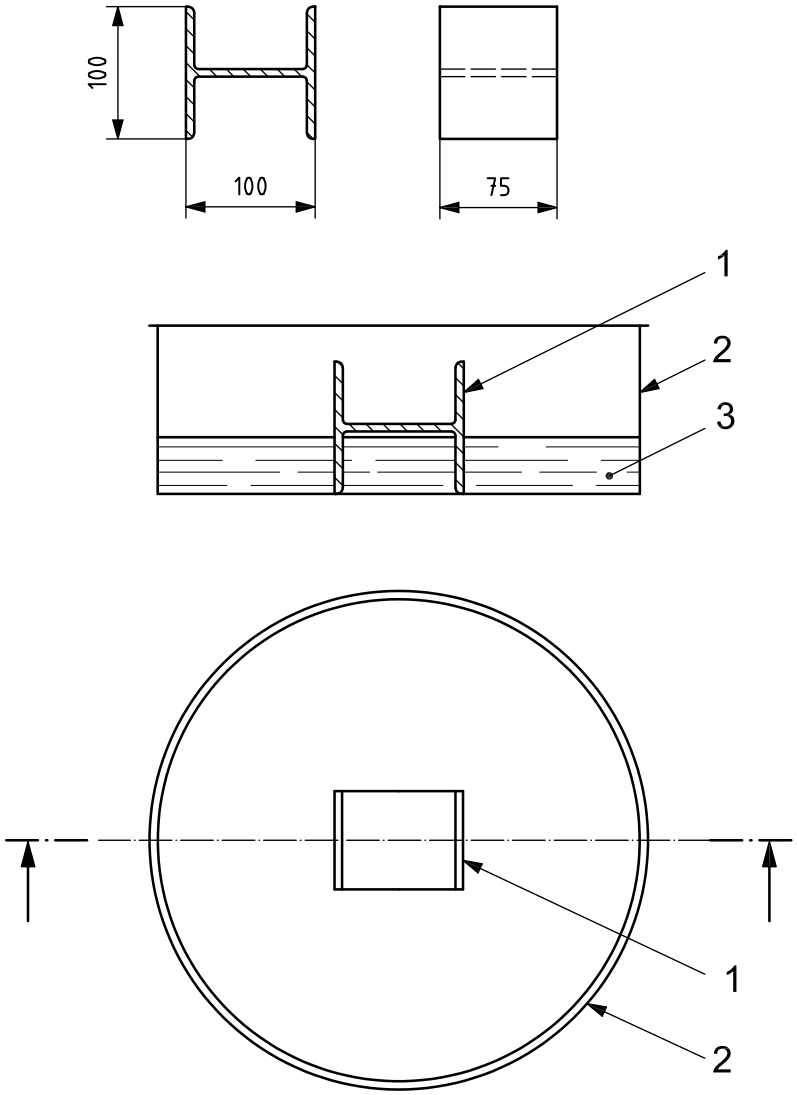
Melt the fuel and allow it to ignite generally as described in 8.5.4.3.1. When the temperature reaches (550 ± 10) °C, remove the pan from the heat source and place it on a level floor, where it may be attacked at the operator's discretion using the manufacturer's recommended extinguishing techniques. After discharge is complete, follow the procedure described in 8.5.4.3.1.

8.5.5 Simulated casting fire

8.5.5.1 General

The fire consists of melted metal poured into the steel tray described in 8.5.4.1, positioned on a level surface with an obstruction, formed from a (50 ± 5) mm length of steel I-beam, 100 mm deep and 100 mm wide, positioned centrally in the tray, on its side in the attitude of an arch, as shown in Figure 3.

Dimensions in millimetres



Key

1 obstruction
2 test pan
3 molten fuel

Figure 3 — Obstructed-magnesium-spill fire configuration

8.5.5.2 Fuel

Use (11,3 ± 0,1) kg of the magnesium alloy described in 8.5.2.2.

8.5.5.3 Procedure

Heat the magnesium alloy in the covered melting pan described in 8.5.4.1 until completely melted. Carefully remove the cover and continue to heat until the temperature reaches (650 ± 10) °C above the melting point. If the fuel does not ignite spontaneously, use the gas torch (see 8.5.2.1) to ignite it. Pour the fuel into the tray, but not directly over the obstruction. As soon as the burning fuel has spread across the tray, the fire can be attacked at the operator's discretion using the manufacturer's recommended extinguishing techniques.

After discharge is complete, follow the procedure described in 8.5.2.3.

8.6 Electrical conductivity of extinguisher discharge

8.6.1 Water-based extinguishers

Water-based extinguishers that are marked as suitable for use on energized electrical equipment fires shall not pass a current of more than 0,5 mA when tested as described in 8.6.3. Water-based models that can be produced with or without an anti-freeze agent shall be treated as separate and distinct models for the electrical conductivity test.

8.6.2 Requirements

Test the extinguisher in accordance with 8.6.3. When the extinguisher is in operation and the metallic plate is live, the current between the handle or the nozzle and earth and between earth and the extinguisher shall be no more than 0,5 mA at any time during the complete discharge duration of the extinguisher.

8.6.3 Test for electrical conductivity

Hang a metal plate, of dimensions (1 m ± 25 mm) × (1 m ± 25 mm), vertically from insulating supports. Connect the plate to a transformer so that an alternating voltage of (36 ± 3,6) kV is established between the plate and earth. The impedance of the circuit should be such that when a voltage equal to 10 % of the normal primary voltage is applied to the primary and the secondary is short-circuited, the current in the secondary is not less than 0,1 mA.

Mount the extinguisher on an insulating support with the nozzle fixed 1 m from the centre of the plate, at right angles to it and directed towards it. Connect the extinguisher to the earth. In the case of an extinguisher with a hose, connect it to the earth by connection at the nozzle. For an extinguisher not fitted with a hose, the connection is at the handle.

Measure any current flowing between the extinguisher and the earth when the plate is live and the extinguisher discharging.

8.7 Class F test fire

8.7.1 Location

Carry out test fires indoors in a draft-free room having dimensions of at least 6 m × 6 m × 4 m high and at an ambient temperature of between 10 °C and 30 °C.

8.7.2 Construction

Details of class F fire test apparatus are given in Figures 4 and 5.

Class F fires utilize a range of welded sheet-metal trays (dimensions are given in Figures 4 and 5). The sides are vertical. The base of the tray is horizontal and level with the surrounding ground or floor.

Each test fire is designated by a number followed by the letter “F”.

8.7.3 Fuel

Class F fires shall be conducted using a vegetable oil having an auto-ignition temperature of not less than 360 °C.

8.7.4 Procedure

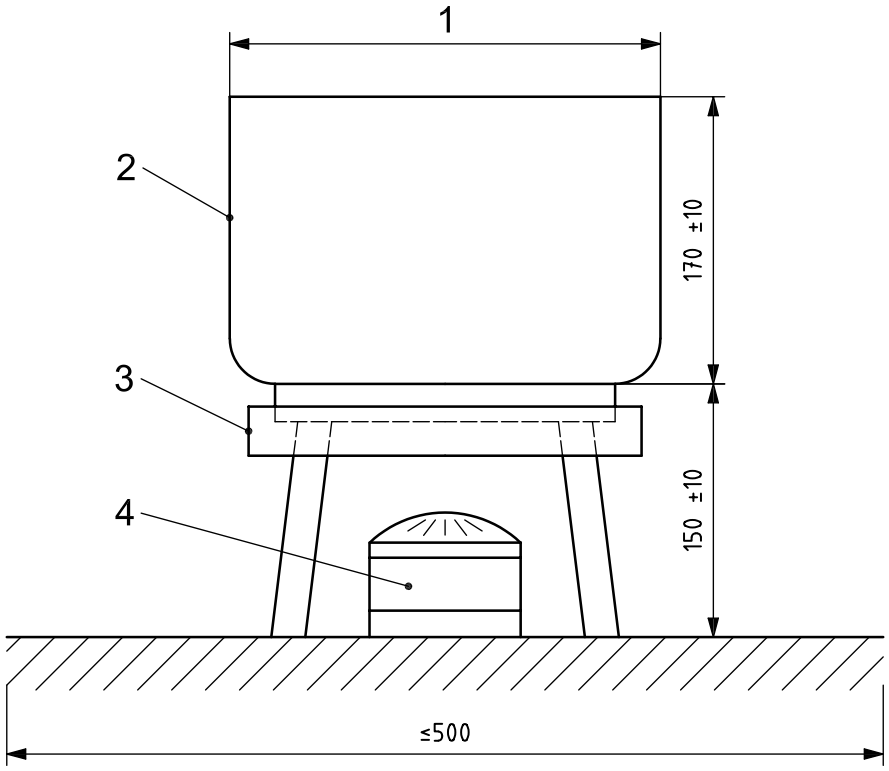
8.7.4.1 Carry out the fire tests indoors. Heat the oil in the test tray using a suitable heating arrangement. Measure the oil temperature at a point 25 mm below the fuel surface and at least 75 mm from the walls of the tray.

8.7.4.2 Heat the tray, uncovered, at the heating source's required input rate. The heating arrangement shall increase the temperature of the fuel at a rate of (5 ± 2) °C/min and shall be recorded during the test between the temperature of 260 °C and the end of the test. Heat the oil until auto-ignition occurs.

8.7.4.3 At auto-ignition, allow the fire to burn freely for 2 min. Turn off the energy source at auto-ignition. After the 2 min pre-burn, discharge the extinguisher onto the tray continuously or intermittently until the extinguisher is fully discharged. The discharge of the extinguisher onto the tray shall be at the distance specified on the extinguisher marking, but shall in no case be less than 1 m between the nozzle and the tray.

8.7.4.4 Use fresh fuel for each test.

Dimensions in millimetres

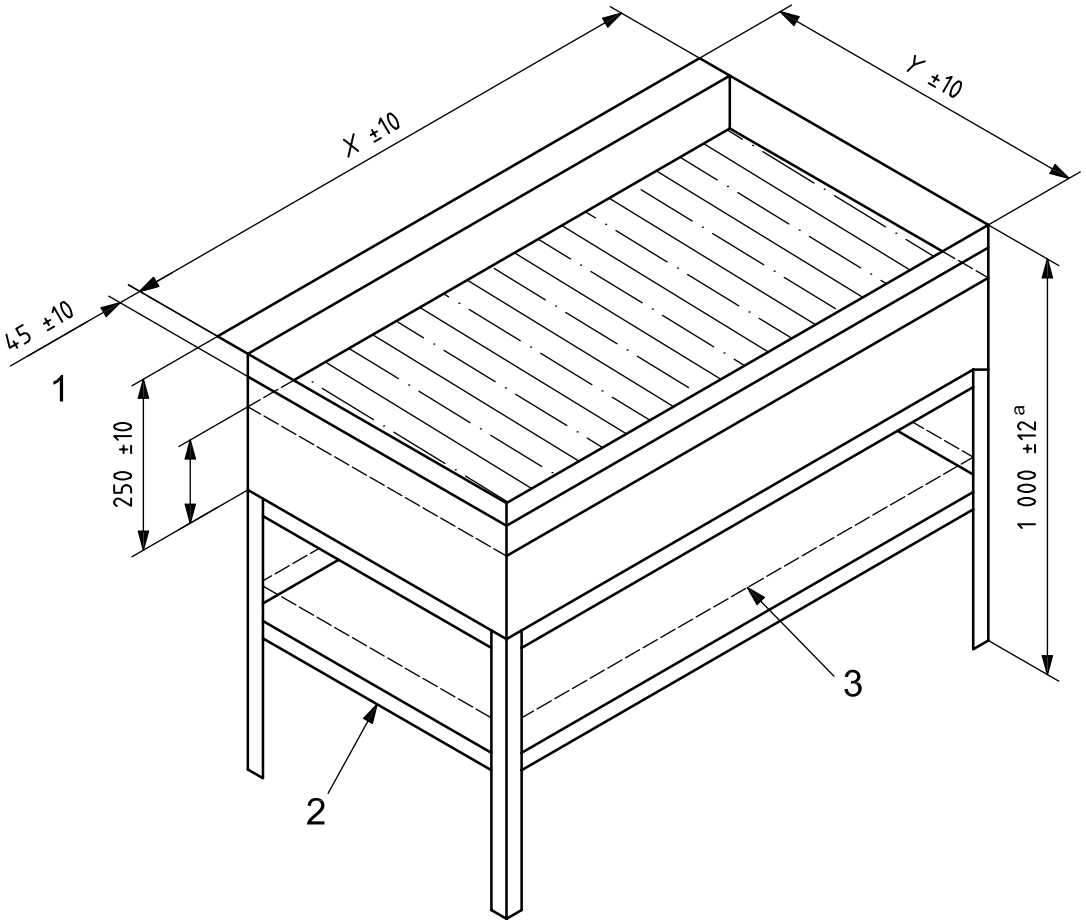


Key

1 pan diameter
2 nominal wall thickness, 2 mm
3 skirt to suit burner type
4 burner

Figure 4 — General dimensions for class F test apparatus — Type A apparatus for class 5F only

Dimensions in millimetres



Key

1 top edge

2 tray to support gas burners (alternatively, electrical heating may be used)

3 skirt to contain flames for gas heating (to prevent piloted ignition)

[a] To floor level.

Figure 5 — General dimensions for class F test apparatus — Type B apparatus for classes 15F, 25F and 75F

8.8 Class F splash test

8.8.1 Location

Carry out test fires indoors in a draft-free room having dimensions of at least 6 m × 6 m × 4 m high and at an ambient temperature of between 10 °C and 30 °C.

8.8.2 Construction

Details of class F fire test apparatus are given in Table 10 and Figures 4 and 5. See Figure 6 for an example of a splash test apparatus.

Class F test fires utilize a range of welded sheet-metal trays (dimensions are given in Table 10 and Figures 4 and 5). The sides are vertical. The base of the tray is horizontal.

Each test fire is designated by a number followed by the letter “F”.

Table 10 — Fire rating and quantity of agent for Class F extinguishers

Rating	Volume of cooking oil in test fire l	Test apparatus mm
5F	$5\,^{+1}_{0}$	Type A diameter = 300
15F	$15\,^{+1}_{0}$	Type B X = 448 Y = 224
25F	$25\,^{+1}_{0}$	Type B X = 578 Y = 289
75F	$75\,^{+1}_{0}$	Type B X = 1 000 Y = 500

8.8.3 Fuel

Class F splash test fires shall be conducted using a vegetable oil having an auto-ignition temperature of not less than 360 °C.

8.8.4 Procedure

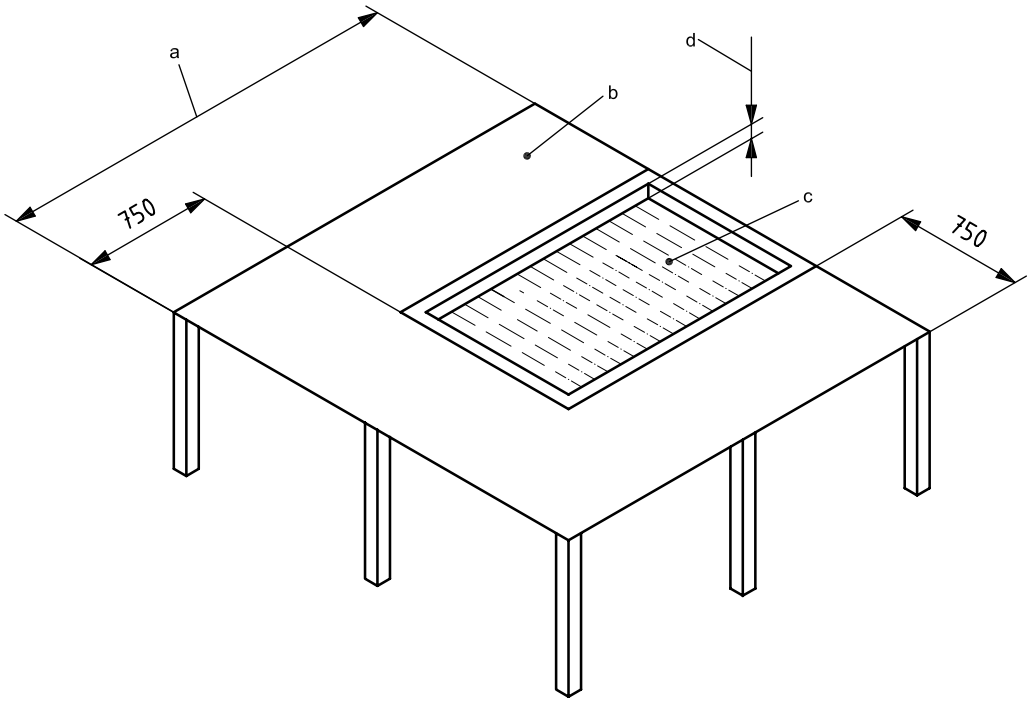
Use fresh fuel for each test.

8.8.4.1 Two tests shall be carried out with the extinguisher conditioned as follows.

— Test 1 Condition for at least 18 h at the maximum operating temperature.

— Test 2 Condition for at least 18 h at the minimum operating temperature.

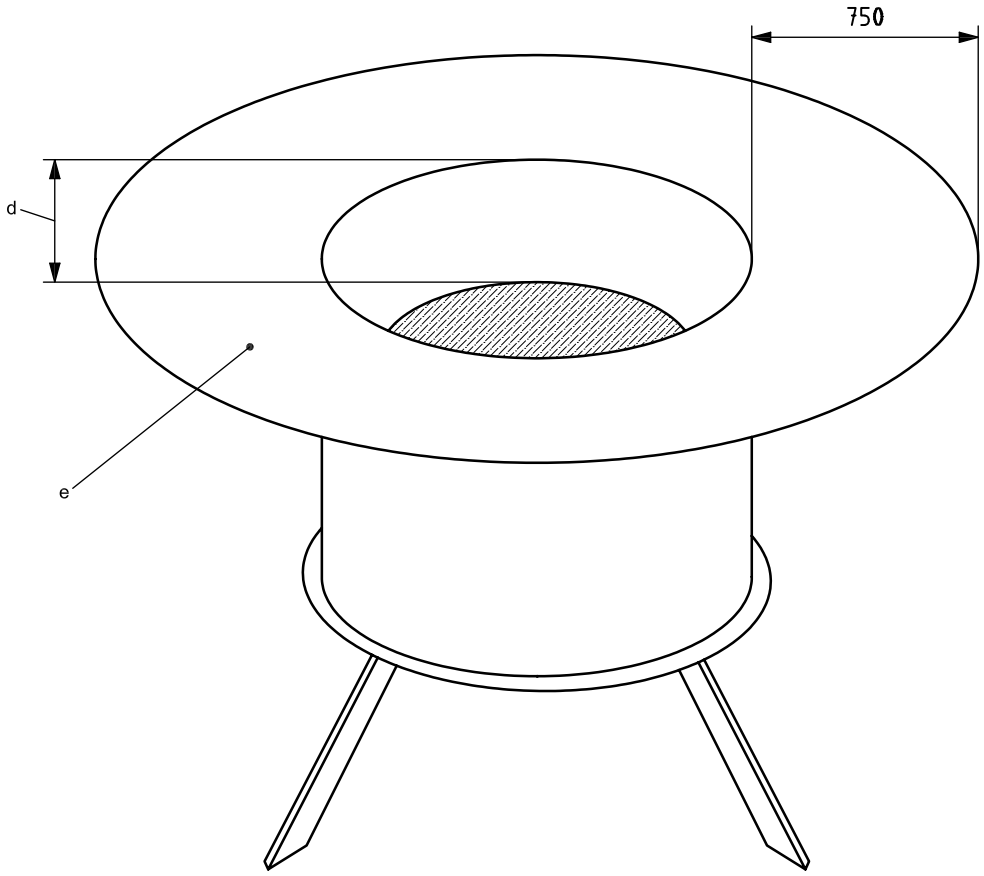
Dimensions in millimetres



a) Classes 15F, 25F and 75F

Figure 6 (*continued*)

Dimensions in millimetres



b) Class 5F

a Length of tray plus 1,5 m.

b Layer of sodium bicarbonate 2 mm deep on table top surface.

c Test tray.

d Free board at 175 °C to 195 °C.

e 2 mm layer of sodium bicarbonate.

Figure 6 — Splash test apparatus example

8.8.4.2 Place a flat surface completely around the fire tray. The flat surface shall be 750 mm wide and positioned at the top edge of the fire tray. The flat surface shall be covered with a layer of sodium bicarbonate powder not more than 2 mm deep. Heat the oil in the fire tray using its heat source until a temperature of 175 °C to 190 °C is achieved. Discharge each conditioned extinguisher fully and continuously toward the centre of the fire tray within 5 min of being conditioned, with the nozzle held at a distance specified by the manufacturer and shown on the nameplate of the extinguisher, but not greater than 2 m. Measure the distance from the front edge of the fire tray to the nozzle.

8.8.5 Requirements

8.8.5.1 The discharge from the extinguishers when tested in accordance with 8.8.1 to 8.8.4 shall not splash grease droplets in excess of 5 mm diameter.

9 Construction requirements

9.1 High-pressure extinguishers

Extinguishers with a service pressure greater than 2,5 MPa (25 bar) shall be fitted with a cylinder that is designed, tested and marked according to national regulations.

9.2 Low-pressure extinguishers

9.2.1 General requirements

9.2.1.1 These requirements are applicable to extinguishers having a service pressure, p_s, not exceeding 2,5 MPa (25 bar).

9.2.1.2 A portable extinguisher with a charge exceeding 3 kg shall be constructed so that it can stand vertically without support.

9.2.1.3 The manufacturer shall ensure that the welds show continuous penetration with no deviation in the weld. Welds and brazed joints shall be free from defects which are prejudicial to the safe use of the cylinder.

The manufacture shall use welders, welding operators and welding procedures that can be demonstrated as suitable for the purpose.

NOTE It is important that users of this International Standard consider the use of appropriate conformity assessment methods. Certification by an independent third party can provide a higher level of confidence in the conformity of products, capabilities of personnel and processes.

9.2.1.4 Parts attached to the body of the extinguisher shall be manufactured and fitted in a way that minimizes stress concentration and corrosion risks. In the case of welded and brazed parts, the metal shall be compatible with the cylinder material.

9.2.1.5 The cylinder manufacturer shall obtain the works certificate for the cast analysis of material supplied and shall keep this available for inspection.

9.2.1.6 Where plastic components are threaded into metallic parts, they shall be designed to minimize the possibility of cross-threading. This shall be accomplished by the use of coarse threads of less than five threads per centimetre or by the use of square-cut threads.

9.2.1.7 Extinguishers that are free-standing either shall be fitted with a means to raise the pressure-retaining part of the body at least 5 mm above the floor or shall have the thickness of metal in the lowest pressure-retaining part(s) of the body at least 1,5 times the minimum thickness of the cylindrical part of the body.

9.2.1.8 The maximum service pressure, p_{ms}, is determined as follows.

9.2.1.8.1 Conduct the test on a minimum of three extinguishers conditioned at 60 °C for 18 h.

9.2.1.8.2 For stored-pressure type extinguishers, determine the pressure immediately after taking each extinguisher out of the oven. For cartridge-operated type extinguishers, remove each extinguisher from the oven and activate the cartridge immediately.

9.2.1.8.3 For each type of extinguisher, the highest pressure observed when carrying out the operation in 9.2.1.8.2 is recorded as the maximum service pressure, p_{ms}.

9.2.2 Burst test

9.2.2.1 Fill the extinguisher with a suitable liquid and increase the pressure at a rate not exceeding (2,0 ± 0,2) MPa/min [(20 ± 2) bar/min] until the minimum burst pressure, p_b, is achieved. Maintain this pressure for 1 min without the cylinder rupturing. The body shall remain tight. Increase the pressure until rupture occurs. The minimum burst pressure, p_b, shall be $2{,}7 \times p_{ms}$ but in no case less than 5,5 MPa (55 bar).

9.2.2.2 The bursting test shall not cause the cylinder to fragment.

9.2.2.3 The break shall not show any sign of brittleness, that is the edges of the break shall not be radial but shall be slanting relative to a diametrical plane and shall exhibit a reduction in area over their entire thickness.

9.2.2.4 The break shall not show any characterized defect in the metal.

9.2.2.5 The break shall not occur in the weld at a pressure less than $5{,}4 \times p_{ms}$ or 8,0 MPa (80 bar), whichever is greater. Furthermore, the break shall not occur in any permanent body marking, such as a stamping or engraving.

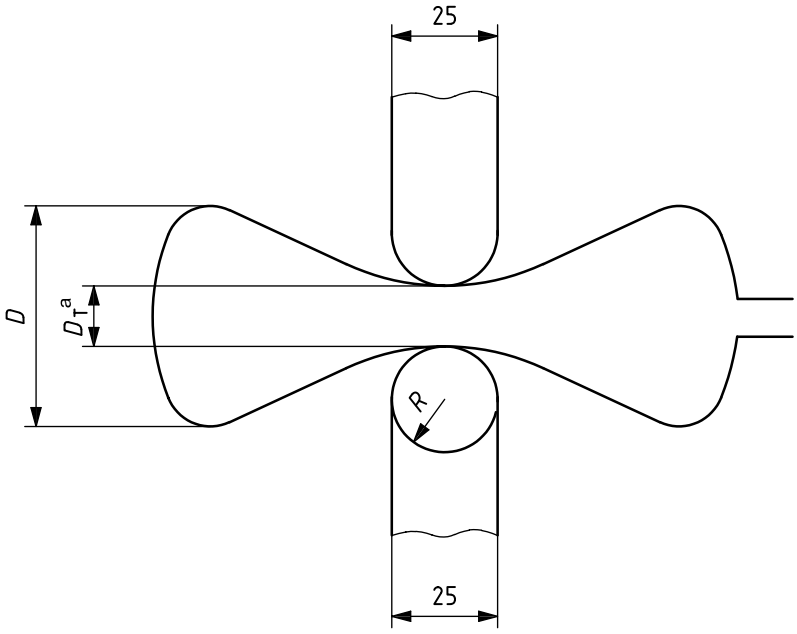
9.2.2.6 During the burst test, no part shall be ejected from the extinguisher. The burst test shall not cause the valve or fitting to fragment. The break shall not originate in the valve or fitting marking area. The fittings shall remain tight.

9.2.3 Crushing test

9.2.3.1 Crush five samples perpendicular to their longitudinal axis and at their midpoint using two 25 mm thick mandrels with a radius at their apex of 12,5 mm and a width sufficient to extend beyond the sides of the extinguisher (see Figure 7). Crush the cylinder over a period of 30 s and 60 s. In the case of extinguishers with a longitudinal weld, place the weld seam at 90° to the support lines. For extinguishers with central transverse welds, apply the mandrel at 45° to the weld seam.

9.2.3.2 After the crushing test, fill the extinguishers with water and increase the pressure to test pressure, p_t. The extinguishers shall not exhibit any cracks or leaks.

Dimensions in millimetres



a D_T, the distance after test, is equal to D, the outside diameter of cylinder, divided by 3; e.g. $D_T = \frac{D}{3}$.

Figure 7 — Crushing test

9.2.4 Permanent volumetric expansion test

There shall be no permanent expansion in excess of 10 % of the total expansion of the cylinder when subjected to the test pressure, p_t, for 30 s. For cylinders that have been proof-pressure tested prior to the deformation test, the test pressure shall be increased by 10 %.

NOTE An acceptable test apparatus is the water-jacket test as described in Reference [2]. Other methods are also acceptable.

9.2.5 Welded low-carbon steel cylinder

9.2.5.1 The cylinder material shall be capable of being welded and shall contain a maximum of 0,25 % mass fraction carbon, 0,05 % mass fraction sulfur and 0,05 % mass fraction phosphorous.

9.2.5.2 Filler material shall be compatible with the steel to give welds with properties equivalent to those specified for the base sheet.

9.2.5.3 The cylinder shall have a measured thickness, S, greater than the minimum thickness, expressed in millimetres, given by Equation (2), but in no case less than 0,70 mm:

$$S = \frac{D}{300} + k \tag{2}$$

where

D is the outside diameter of the cylinder or, for non cylindrical bodies, the greatest external diagonal of the extinguisher body, expressed in millimetres;

k is the coefficient equal to

0,45 for $D \leqslant 80$;

0,50 for $80 < D \leqslant 100$;

0,70 for $D > 100$.

9.2.6 Stainless steel cylinders

9.2.6.1 Stainless steel domes and bottoms shall be drawn from fully annealed stock.

9.2.6.2 Only austenitic stainless steel having a maximum carbon content of 0,03 % mass fraction shall be used.

NOTE An example of such steel is ASTM A240, type 304L (UNS designation S30403).

9.2.6.3 The cylinder shall have a minimum measured wall thickness, S, greater than the minimum wall thickness, expressed in millimetres, given by Equation (3), but in no case less than 0,64 mm:

$$S = \frac{D}{600} + k \tag{3}$$

where

D is the outside diameter of the cylinder or, for non cylindrical bodies, the greatest external diagonal of the extinguisher body, expressed in millimetres;

k is equal to 0,3.

9.2.7 Aluminium cylinders

9.2.7.1 Aluminium cylinders shall be of a seamless construction.

9.2.7.2 Aluminium cylinders shall have a measured wall thickness greater than or equal to the minimum thickness given by Equation (2), but in no case less than 0,71 mm.

9.3 Carrying handle

9.3.1 An extinguisher having a total mass of 1,5 kg or more and having a cylinder diameter of 75 mm or more shall have a carrying handle.

The valve assembly head itself may be considered a handle, provided it meets the requirements of 9.3.2 and 9.3.3.

9.3.2 A handle shall be no less than 90 mm long for an extinguisher of 7,0 kg or more total mass and no less than 75 mm long for an extinguisher of less than 7,0 kg total mass.

9.3.3 There shall be no less than 25 mm clearance between the extinguisher body and the carrying handle when the handle is in the carrying position.

9.4 Mounting

9.4.1 Each extinguisher intended for wall mounting shall be provided with a means of mounting. Carry out the testing on only one extinguisher bracket of each model or type supplied with the extinguisher.

9.4.2 A wall mounting hook shall require both a horizontal and a minimum 6 mm vertical motion to remove the extinguisher from the wall, except that a minimum vertical motion of 3 mm is acceptable for an extinguisher having a gross mass of 5,4 kg or less.

9.4.3 A mounting bracket shall be capable of withstanding a static load of five times the fully charged mass of the extinguisher, but no less than 45 kg when tested in accordance with 9.4.4.

9.4.4 Place an extinguisher charged to its rated capacity in the mounting bracket provided with the extinguisher after the mounting bracket has been secured to a wood board. Secure the board in a vertical position and apply a static load of four times the full extinguisher mass (or a total load of 45 kg minus the full extinguisher mass, minimum) to the top of the extinguisher. Hold the load for 5 min.

9.4.5 A mounting bracket equipped with a strap shall not permit the extinguisher to drop to the floor when the strap clamp is opened. The clamp releasing device shall be of a colour contrasting with that of the immediate extinguisher background and shall be visible. The method of release shall be obvious when viewing the front of the extinguisher.

9.4.6 A hanger loop shall be located so that the operating instructions face outward when the extinguisher is supported by the mounting means.

9.5 Caps, valves and closures

9.5.1 Cylinder caps, valves and closures shall be designed to provide release of pressure before complete disengagement.

9.5.2 Threaded connections on a cylinder shall have at least four full threads of engagement and be required to relieve pressure with at least two full threads of engagement. Other types of valves, caps and closures are permissible if they can satisfy the same requirements, particularly with regard to recurrent tests and filling.

9.5.3 The inside diameter of a filling opening for a rechargeable type extinguisher shall be no less than 19 mm.

9.5.4 An extinguisher collar with external threads shall have sufficient height so that the cap or valve does not contact the dome or bottom with the gasket removed.

9.5.5 A cap, valves or closure shall withstand the burst test pressure specified for the cylinder for 1 min without rupture. For this test, remove or plug pressure-relief devices.

9.5.6 The edges and surfaces of a fire extinguisher and its mounting bracket shall not be sufficiently sharp to constitute a risk of injury to persons during intended use or while performing maintenance.

NOTE One method of evaluating sharpness of edges is described in ANSI/UL 1439.

9.6 Safety devices

9.6.1 High-pressure cylinders and cartridges shall be provided with a safety device in accordance with national regulations.

9.6.2 There are no compulsory safety systems required for low-pressure extinguishers. However, if such a system is used, it shall be appropriately sized and positioned. The operating pressure of the device shall not exceed the test pressure, p_t, nor be less than the maximum service pressure, p_{ms}.

9.7 Manufacturing tests

9.7.1 Low-pressure cylinders

9.7.1.1 Subject at least one cylinder from each batch of 500 or less to the crush and burst tests. If the test results are not acceptable, randomly select five additional cylinders from the same batch and repeat the tests. If one of the cylinders does not pass the test, the batch is rejected and made unserviceable. At the option of the manufacturer, the burst and crushing tests may be conducted on the same cylinder. If a cylinder that has successfully passed the crushing test fails the burst test, it shall not be considered as a failure and another one from the same batch may be utilized for the burst test.

9.7.1.2 Each cylinder shall be subjected to the test pressure, p_t, for 30 s, without leakage, failure or visible deformation.

9.7.2 Leakage tests

Each stored-pressure and carbon dioxide extinguisher and gas cartridge shall be subjected to a leakage test and comply with the following requirements.

a) For stored-pressure extinguishers fitted with a gauge as specified in 7.4.1.3, the leakage rate shall not exceed a rate of loss of pressurizing content equivalent to 6 %/yr of service pressure.

b) For gas cartridges and stored-pressure extinguishers without gauges as specified in 7.4.1.2, the maximum loss of contents per year shall not exceed the following:

   — for extinguishers: 5 % or 50 g, whichever is less,

   — for gas cartridges: 5 % or 7 g, whichever is less.

c) For carbon dioxide extinguishers, the maximum loss of contents shall not exceed 6 %/yr.

9.8 Requirements for plastics components

9.8.1 General requirements

Plastics components of portable fire extinguishers shall comply with the following requirements.

a) The test and conformity checks shall be carried out on components that correspond to the mass-produced components as regards the material used, the form and the method of manufacture.

b) Any change in the material, the form or the method of manufacture requires a new test.

c) It is recommended that the plastic used be identifiable at all times.

d) It is necessary to have access to data supplied by the manufacturer relating both to the material itself and the manufacturing procedures.

To verify the attachment of plastic parts following the air-oven ageing, ultraviolet light exposure and impact-resistance tests, attach the plastic part(s) to an extinguisher and then subject the assembly to the appropriate pressure test.

9.8.2 Requirements for normally pressurized components

9.8.2.1 Burst strength

9.8.2.1.1 Conduct burst tests at three temperatures as described below:

Subject at least three components to the burst test in accordance with 9.2.2 using an appropriate liquid at temperatures of (20 ± 3) °C, the minimum recommended operation temperature marked on the extinguisher (see 7.1) and (60 ± 3) °C. Increase the pressure at a rate of (2,0 ± 0,2) MPa/min [(20 ± 2) bar/min].

9.8.2.1.2 The bursting pressure before and after the ageing and ultraviolet light exposure test shall be at least equal to the minimum burst pressure, p_b.

9.8.2.2 Air-oven ageing

9.8.2.2.1 Subject at least three components to accelerated ageing in an oven at 100 ± 3 °C for 180 days. Fit the components with adapters to apply normal assembly stresses.

9.8.2.2.2 Following the exposure, condition the components for 5 h at (20 ± 3) °C and subsequently inspect them for cracking. No cracking shall be permitted.

9.8.2.2.3 Subject the components to the burst test in accordance with 9.2.2 at (20 ± 3) °C using a suitable liquid at a rate of pressure increase of (2,0 ± 0,2) MPa/min [(20 ± 2) bar/min]. The minimum burst pressure, p_b, shall be at least equal to that specified for the cylinder.

9.8.3 Ultraviolet light exposure

9.8.3.1 Subject at least six components to an artificial weathering test in accordance with 9.8.3.4 for 500 h and then condition them for 5 h at (20 ± 5) °C.

9.8.3.2 Following the exposure, inspect the samples for cracking. No cracking shall be permitted.

9.8.3.3 Subject the components to the burst test in accordance with 9.2.2 at (20 ± 5) °C using a suitable liquid at a rate of pressure increase of (2,0 ± 0,2) MPa/min [(20 ± 2) bar/min]. The minimum burst pressure, p_b, shall be at least equal to that specified for the cylinder.

9.8.3.4 Use two stationary, enclosed carbon-arc lamps to obtain the ultraviolet light. The arc of each lamp shall be formed between two vertical carbon electrodes, 12,7 mm in diameter, located at the centre of a removable vertical metal cylinder 787 mm in diameter and 450 mm in height. Enclose each arc in a clear borosilicate-glass globe. Mount the samples vertically on the inside of the revolvable cylinder, facing the lamps, and revolve the cylinder continuously around the stationary lamps at 1 r/min. Provide a system of nozzles to spray each sample, in turn, with water as the cylinder revolves. During each operating cycle (total of 20 min), expose each sample to the light and water spray for 3 min and to the light only for 17 min. Maintain the air temperature within the revolving cylinder of the apparatus during operation at (63 ± 5) °C.

An acceptable alternate test is described in ISO 4892-2:2006, method A, using a xenon arc source for a period of 500 h. Use the following conditions:

a) (65 ± 3) °C black panel temperature;

b) (50 ± 5) % relative humidity;

c) spray cycle of 102 min dry interval, 18 min water spray;

d) total dose of exposure of 1 GJ/m^2 (500 h at 550 W/m^2).

9.8.4 Impact resistance

9.8.4.1 Mount at least four samples subjected to the ageing test (see 9.8.2.2) (two with and two without the safety-locking device engaged), and pressurize the extinguisher cylinder to the maximum service pressure, p_{ms}, with nitrogen after being filled 95 % with a water and anti-freeze solution. Test the samples at (−20 ± 3) °C or at the minimum recommended operation temperature, whichever is lower. The test is carried out as described in 7.5.1.

9.8.4.2 No hazardous changes shall occur to the valve assembly, such as splinters, fractures or cracks.

The valve shall then be capable of withstanding the test pressure, p_t, for 1 min without bursting.

9.8.5 Normally non-pressurized components

9.8.5.1 Subject plastic extinguisher components that withstand pressure during extinguisher operation to the burst, air-oven ageing and impact-resistance tests. The air-oven exposure is either 100 °C for 70 days or 87 °C for 180 days at the manufacturer's choice.

9.8.5.2 External plastic components shall comply with the ultraviolet light test.

9.8.6 Test for exposure to extinguishing medium

9.8.6.1 There shall be no damage to polymeric siphon tubes that have been conditioned in accordance with 9.8.6.3, when installed in test extinguishers and subjected to the mechanical resistance test described in 7.5.

9.8.6.2 Following conditioning in accordance with 9.8.6.3, ring samples cut from polymeric siphon tubes shall not exhibit degradation in excess of 40 % of the original tensile or ring-crushing-strength value.

9.8.6.3 Place complete siphon tubes in contact with the medium with which they are being used. Totally cover or immerse ring samples, 12,7 mm wide, cut from unaged siphon tubes in the medium. Ensure that the samples do not touch each other or the container holding the medium and samples. Place the container of the medium, with the samples in place, in a preheated oven at (90 ± 3) °C for 210 days. After the test exposure, cool the samples in air at (23 ± 2) °C for at least 24 h before any tests or dimensional measurements are conducted. Subject the ring samples to a crush test between two parallel, flat plates using a testing machine capable of applying a compressive load at a uniform rate of 5 mm/min and recording the load versus the deflection. If the nature of the material is such that meaningful test results cannot be obtained, other tests, such as tensile tests, may be conducted.

9.9 Hose assemblies

9.9.1 Extinguishers with a charge greater than 3 kg or 3 l shall be equipped with a hose assembly having a minimum length of 400 mm (see Figure 8). When an extinguisher of less than 3 kg or 3 l is fitted with a hose, the minimum length of the hose shall be 250 mm.

Dimensions in millimetres

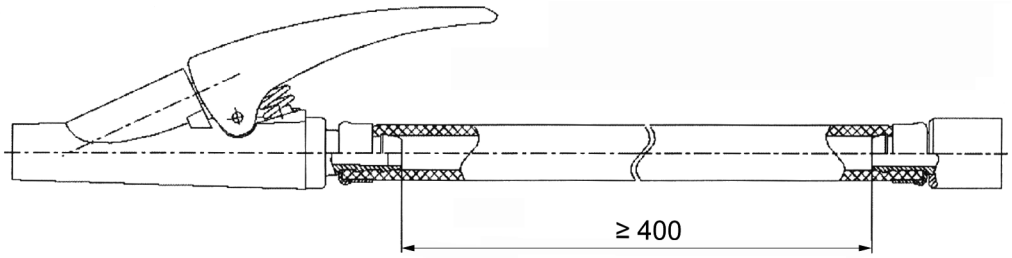


Figure 8 — Minimum hose length

9.9.2 The hose and coupling system shall function throughout the operating temperature range, and coupling systems shall be designed and fitted in such a way that they cannot damage the hose.

9.9.3 The burst pressure of a hose assembly fitted with a shut-off nozzle shall be equal to or greater than the appropriate value below:

a) for all types, except CO_2 and clean agent extinguishers:

— 3,0 times the maximum service pressure, p_{ms}, with the test carried out at (20 ± 5) °C;

— 2,0 times the maximum service pressure, p_{ms}, with the test carried out at (60 ± 2) °C.

b) for CO_2 and clean agent extinguishers:

— 1,5 times the maximum service pressure, p_{ms}, the test carried out at (20 ± 5) °C;

— 1,25 times the maximum service pressure, p_{ms}, the test carried out at (60 ± 2) °C.

The test pressure shall be established by increasing the pressure to the minimum allowable burst pressure during an interval of no less than 30 s, maintaining that pressure for 30 s during which failure shall not occur and then increasing the pressure until failure.

Where testing is carried out at (60 ± 2) °C, condition the hose and attached components at the relevant temperature for a period of no less than 12 h.

The hose shall be fitted to a means of providing the required pressure and the open end blanked off by suitable means. The hydraulic test fluid shall not cause the hose assembly to decrease in temperature.

Record the pressure at which the hose bursts.

9.9.4 A hose assembly without a shutoff nozzle shall be capable of withstanding, without leakage, a hydrostatic pressure equal to the extinguisher test pressure, p_t, held for at least 30 s.

9.9.5 Hose assemblies shall be subjected to a low-temperature flexibility test in accordance with ISO 4672:1997, method B. The mandrel shall be 150 mm in diameter, and the length of hose shall be 600 mm. The test shall be carried out at a temperature of T_{min}. After the flexibility test, there shall be no leakage of the hose assembly when tested to test pressure, p_t, at (20 ± 5) °C for 30 s.

9.10 Method of operation

The extinguisher shall be operated by piercing, opening and/or breaking a sealing device, thus releasing its contents. Extinguishers shall operate without inversion. It shall not be necessary for any movement of the actuating mechanism to be repeated in order to initiate discharge of the extinguisher. The force or the energy necessary to operate the extinguisher shall not exceed the values given in Table 11 for temperatures of up to 60 °C.

The energy of 2 J is obtained by allowing the 4 kg mass used in the mechanical resistance (impact) test described in 7.5 to fall from a height of 50 mm. The impact shall be applied in the direction of the operating mode.

Table 11 — Force or energy required to operate the extinguisher

Type of operation	Maximum force required N	Energy J
With one finger	100	
With full hand	200 [a]	
With impact (strike knob)	—	2

[a] For carbon dioxide extinguishers, this maximum force may be increased to 300 N.

9.11 Safety-locking devices

9.11.1 The operating mechanism shall be provided with a safety device to prevent inadvertent operation. The release of the safety device with a tamper indicator shall involve an operation distinct from that of the operation mechanism and shall require a force of no less than 20 N but not exceeding 100 N. It shall be possible to determine whether the apparatus might have been operated.

9.11.2 The safety device shall be so constructed that any unaided manual attempt, using a force or impact equal to twice the relevant value given in Table 11 to initiate discharge, without first operating this device, does not deform or break any part of the mechanism in such a way as to prevent the subsequent discharge of the extinguisher.

9.11.3 The safety-locking pin or other device shall be visible from the front of the extinguisher when the extinguisher is mounted in its mounting bracket.

EXCEPTION The safety-locking pin may be on the reverse side of the extinguisher if pictographic operating instructions on the front illustrate the intended method of operation.

9.11.4 If the safety-locking device is attached to the extinguisher by a chain or similar device, the chain shall be attached so as to not interfere with the discharge stream.

9.11.5 A tamper indicator, such as a seal, shall be provided to retain the safety-locking device in place and to indicate tampering with or use of the extinguisher.

9.11.6 The tamper indicator shall be constructed so it is necessary that it be broken to operate the extinguisher. The force required to break the tamper indicator shall not exceed 70 N.

EXCEPTION If the tamper indicator is broken by the action needed to start discharge of the extinguisher, or if an internal load is continuously applied to the release mechanism, the force required to accomplish discharge or release of the internal load may exceed 70 N but shall not exceed 140 N.

9.12 Requirements for pressure gauges and indicators for low-pressure extinguishers

9.12.1 General

9.12.1.1 A rechargeable extinguisher of the stored-pressure type (except carbon dioxide) employing a single chamber for both the extinguishing medium and the expellant gas shall be equipped with a pressure gauge to show the amount of pressure in the chamber, regardless if the valve is opened or closed.

EXCEPTION The pressure gauge may be omitted on an extinguisher having a disposable, non-refillable, sealed chamber, if a device such as an indicator is used to verify that the extinguisher is charged with the correct quantity of expellant gas.

9.12.1.2 The operable pressure range of the gauge shall reflect the operating temperature-pressure relationship of the extinguisher. (See 7.1.)

9.12.1.3 The pressure gauge face shall indicate the appropriate units for which the gauge is calibrated, such as kilopascals, bar or any combination of pressure units.

9.12.1.4 The maximum indicated gauge pressure shall be between 150 % and 250 % of the indicated service pressure, p_s, at 20 °C, but no less than 120 % of the maximum service pressure, p_{ms}. The gauge dial shall indicate, in green, the operable pressure range of the extinguisher. The zero, service and maximum indicated gauge pressures shall be shown in numerals and with marks. The numerals and marks shall be in close proximity to the respective indications. The background of the gauge face above a horizontal line through the lowest required markings shall be red. The arc of the dial from the zero pressure point to the lower end of the operable range shall read “Recharge”. The arc of the dial from the higher end of the operable range to the maximum indicated pressure shall read “Overcharged”. All numerals, letters and characters in the recharge, operable and overcharge portions of the dial shall be white. Pointers shall be yellow, and the tip of the pointer shall end in the arc of the pressure-indicating dots and shall have a maximum tip radius of 0,25 mm.

The length of the pointer from the point of rotation of the pointer to the tip, measured at the zero pressure point, shall be at least 9 mm for extinguishers having a charge greater than 2 kg or at least 6 mm for extinguishers having a charge of 2 kg or less. The length of the arc from zero pressure to the indicated service pressure shall be at least 12 mm for extinguishers having a charge greater than 2 kg or at least 9 mm for extinguishers filled with clean agents or having a charge of 2 kg or less.

9.12.1.5 The mark used to indicate the service pressure at 20 °C should be no less than 0,6 mm and no more than 1,0 mm wide.

9.12.1.6 The pressure gauge face shall be marked to indicate the appropriate extinguishing medium with which it can be used.

Pressure gauge markings shall be subjected to UV testing as specified in 9.8.3. There shall be no significant deterioration of the legibility, such as darkening, fogging or fading, on completion of the UV testing.

9.12.1.7 The pressure gauge shall be marked with the gauge manufacturer's identifying mark. The pressure gauge shall also be marked according to the following, if applicable, using a line extending as wide as, and of the same stroke thickness as, the manufacturer's identifying mark as follows:

a) to indicate galvanic compatibility with aluminium valve bodies: a horizontal line above the manufacturer's identifying mark;

b) to indicate galvanic compatibility with brass valve bodies: a horizontal line below the manufacturer's identifying mark;

c) to indicate galvanic compatibility with aluminium and brass valve bodies: a line above and a line below the manufacturer's identifying mark.

9.12.2 Calibration test — Gauges and indicators

9.12.2.1 An indicator shall be accurate to within 4 % of the service pressure, p_s, at the lower limit of the operable range.

9.12.2.2 The error of a pressure gauge at the indicated service pressure, p_s, shall not exceed ± 4 % of the service pressure.

The error at the upper and lower limits of the operable range shall not exceed the following percentages of the service pressure:

— ± 4 % for powder and water-based extinguisher gauges;

— ± 8 % for clean agent extinguisher gauges.

At the zero pressure mark, the error shall not exceed 12 % nor fall below 0 % of the service pressure, p_s.

At the maximum indicated pressure, the error shall not exceed ± 15 % of the service pressure, p_s.

9.12.2.3 Install the pressure gauge or indicator on a deadweight gauge tester or a piping apparatus with a master gauge having an accuracy of no less than 0,25 %. The pressurizing medium may be oil, water, nitrogen or air, but all tests on a given type of gauge shall be conducted using the same medium. Apply the pressure to the gauge under test in uniform increments until the upper limit of the gauge is reached. Then, reduce the pressure in the same increments until the zero point is reached. Record the pressure applied, the gauge or indicator reading and net error for each increment in both the increasing and decreasing pressure conditions.

9.12.3 Burst strength test — Gauges and indicators

9.12.3.1 A pressure gauge or an indicator shall withstand, for 1 min, a pressure of six times the indicated service pressure without rupture. In addition, if the Bourdon tube or pressure-retaining assembly bursts at a pressure less than eight times the indicated service pressure, no parts of the device shall be discarded.

9.12.3.2 Attach the sample gauge or indicator to a hydraulic pressure pump after all air has been excluded from the test system. Place the sample in a test cage and apply pressure at a rate of approximately 2,0 MPa/min until the required test pressure is reached. Hold the pressure at this point for 1 min, then increase the pressure until rupture occurs or eight times the indicated service pressure is reached, whichever occurs first.

9.12.4 Overpressure test — Gauges

9.12.4.1 The difference in readings of indicated service pressure before and after a pressure gauge has been subjected for 3 h to a pressure of 110 % of the indicated gauge capacity shall not exceed 4 % of the indicated service pressure.

9.12.4.2 Subject sample pressure gauges to the required test pressure for 3 h. Then release the pressure and allow the gauges to stand at zero pressure for 1 h. Subject the gauges to the calibration test described in 9.12.2.

9.12.5 Impulse test — gauges

9.12.5.1 The difference in readings of the indicated service pressure before and after a pressure gauge is subjected to 1 000 cycles of pressure impulse shall not exceed 4 % of the indicated service pressure.

9.12.5.2 Attach the sample pressure gauges to a regulated source of pressure, either air, nitrogen or water. Vary the pressure from 0 % to 125 % of the indicated service pressure or 0 % to 60 % of the gauge capacity, whichever is higher, and then back to 0 % at a rate of six complete cycles each minute. The subject the samples to the calibration test described in 9.12.2.

9.12.6 Pressure gauge relief test

9.12.6.1 A pressure gauge shall have a pressure relief that vents in the event of a Bourdon tube leak. This pressure relief shall function at a pressure of 345 kPa or less within 24 h. The minimum flow capacity of the pressure relief shall be 1 l/h.

9.12.6.2 Conduct this test on pressure gauges with the Bourdon tube cut completely through. Immerse the gauge in water, with the gauge inlet connected to a regulated source of air or nitrogen. Maintain the supply pressure at 345 kPa until the pressure relief functions, or for 24 h, whichever is shorter. Measure the flow rate with an inverted water column or other equivalent means.

9.12.7 Water resistance test — Gauges and indicators

A gauge or indicator for use on an extinguisher shall remain watertight after being immersed at a depth of 0,3 m in water for 2 h and after being subjected to the salt-spray corrosion test (see 7.6.1).

9.12.8 Leakage test — Gauges and indicators

9.12.8.1 A pressure gauge or indicator shall not leak at a rate in excess of 1×10^{-6} cm^3/s when the gauge or indicator (including a pin-type indicator) is exposed to a pressure equivalent to the intended service pressure of the extinguisher at 20 °C.

9.12.8.2 Use a leak-detection apparatus and leak standard to verify compliance with the requirements specified in 9.12.8.1. The leak-detection apparatus shall be capable of signalling, and the leak standard capable of generating, a leakage rate of 1×10^{-6} cm^3/s.

9.12.8.3 Apply a pressure equivalent to the intended working pressure of the extinguisher at 20 °C to each of twelve sample gauges or indicators. Subject each sample gauge or indicator, other than a pin-type indicator, to a leak test by checking all pressurized components for leakage in order to verify compliance with the requirements in 9.12.8.1. Test each pin-type indicator for leakage by checking the opening sealed by the indicator for leakage. None of the samples shall exhibit leakage at a rate in excess of 1×10^{-6} cm^3/s.

9.12.9 Plastics components — Gauges and indicators

Plastic components of gauges and indicators shall meet the requirements given in 9.8.

9.13 Dip-tubes and filters — Water-based extinguishers

9.13.1 The dip-tube and filter of water-based extinguishers shall be constructed of materials resistant to the extinguishing medium (see 9.8.6).

9.13.2 The extinguishing medium from water-based extinguishers shall be discharged through a filter. The filter shall be placed upstream of the smallest section of the discharge passage. Each orifice of the filter shall have an area less than that of the smallest cross-section of the discharge passage. The total area of the combined filter orifices shall be at least equal to eight times the smallest section of the discharge passage. The filter shall be accessible to facilitate maintenance operations on the portable fire extinguisher.

9.14 Special requirements for CO_2 extinguishers

The extinguisher horn shall be constructed to withstand crushing when 25 kg is applied to its extremity for 5 min immediately after having completely discharged the extinguisher through the horn.

Subject the horn to the following test.

a) Condition the horn at 60 °C for 18 h.

b) Attach the horn to a fully charged extinguisher.

c) Discharge the extinguisher with the valve fully open.

d) Subject the horn to a static load of 25 kg using a circular contact surface of 50 mm diameter for 5 min applied at the end of the horn.

e) Check that the horn does not show any evidence of cracking or breakage.

9.15 Gasket and O-rings

9.15.1 Tensile strength, elongation, maximum set and hardness

Any elastomer (rubber facing, O-ring or "vulcanized-in-place" seat) used to provide a seating surface shall have the following properties:

a) as received:

   1) minimum tensile strength of 3,4 MPa for silicone rubber (having polyorgano-siloxane as its characteristic constituent) or fluorocarbons (8,3 MPa for other elastomers),

   2) minimum ultimate elongation of 100 % for silicone rubber and 150 % for other elastomers,

   3) maximum set of 5,0 mm when 25 mm marks are stretched to 50 mm for silicone rubber and 62,5 mm for other elastomers, held for 2 min, and measured 2 min after release;

b) after conditioning for 96 h in oxygen at 70 °C and 2,1 MPa:

   1) minimum percent of original tensile strength: 70 %,

   2) minimum percent of original elongation: 70 %.

The size and shape of a rubber part determine which of the tests specified can be conducted. Subject, in general, a part larger than 25 mm diameter to all tests. For a circular cross-section O-ring smaller than 25 mm but larger than 12,5 mm, omit the elongation test. For a circular cross-section O-ring smaller than 12,5 mm, omit the elongation and tensile strength tests. For an O-ring less than 25 mm in diameter with a generally square-shaped cross-section, omit the tensile strength and elongation tests. If the size of the part precludes accurate testing, subject larger samples of similar parts made of the same compound to those tests omitted on the parts.

9.15.2 Compression set

9.15.2.1 A sample of a rubber or rubber-like part shall have a compression set no greater than 25 % of its original thickness after being compressed by one-third of its original thickness.

9.15.2.2 Conduct the compression set test on button samples compressed by one-third of their original thickness for 24 h at 20 °C, at the minimum operating storage-and-use temperature and at 60 °C.

10 Marking and colour

10.1 Colour

The recommended colour for extinguisher bodies is red.

10.2 Marking

NOTE An example of the layout for marking is given in Figure 9.

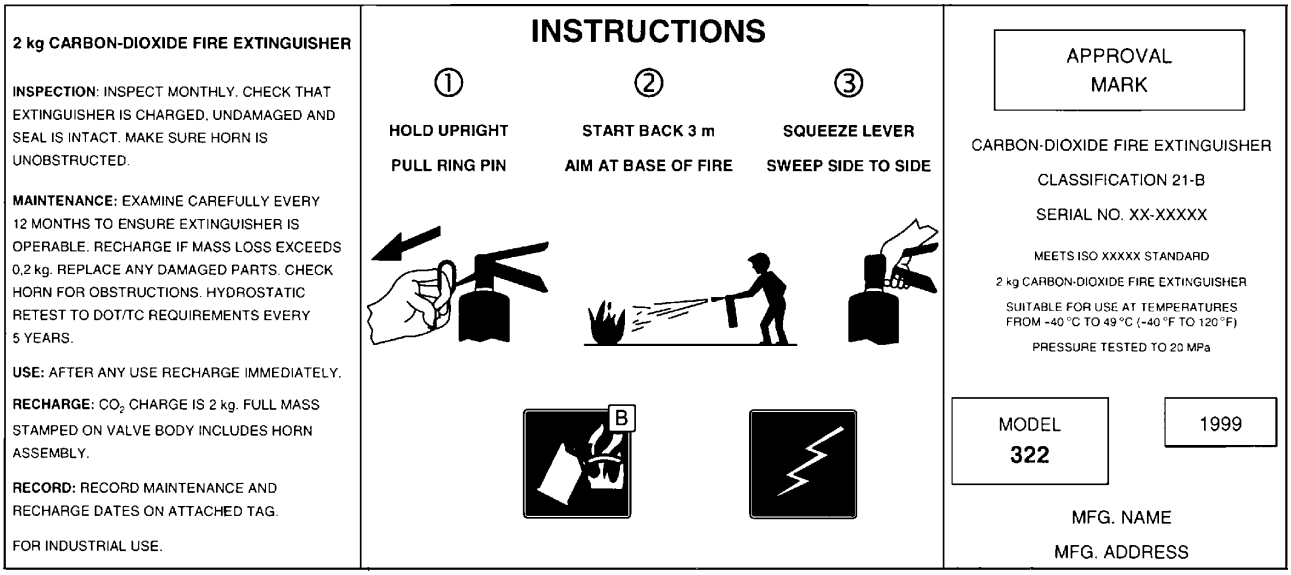


Figure 9 — Marking layout for an extinguisher

10.2.1 General

10.2.1.1 The operating, recharging inspection and maintenance instructions shall be in the form of an etched or embossed metal nameplate or band, or an acceptable pressure-sensitive nameplate attached to the side of the extinguisher body, or in the form of silk-screening of paint directly on the extinguisher body. The marking shall identify the extinguisher as to type of media and shall include the manufacturer's name and model number and the rating and classification of the fire extinguisher.

10.2.1.2 The marking shall include a sequential serial number.

10.2.1.3 The year of manufacture, or the last two digits of the calendar year, and the factory test pressure shall be permanently marked into the extinguisher body or non-transferable nameplate. Extinguishers manufactured in the last three months of a calendar year may be marked with the following year as the date of manufacture, and extinguishers manufactured in the first three months of a calendar year may be marked with the previous year as the date of manufacture.

10.2.1.4 If a manufacturer produces extinguishers at more than one factory, each extinguisher shall have a distinctive marking to identify it as the product of a particular factory.

10.2.1.5 The marking shall include a reference to the range of temperatures at which the extinguisher is usable such as “Acceptable to use at temperature from....to.....” or the equivalent.

10.2.1.6 The following applicable statement or the equivalent shall be included in the marking:

a) for rechargeable extinguishers: “Recharge immediately after any use”;

b) for disposable extinguishers: “Discard immediately after any use”.

10.2.1.7 The gas cartridge shall be permanently marked with

a) the empty mass, expressed in grams;

b) the nominal full mass, expressed in grams;

c) the mass below which it shall be replaced or recharged;

d) the year of manufacture;

e) the name or code of the manufacturer.

The above information may be placed on the cartridge in the form of a decalcomania transfer if the cartridge is mounted on the outside of the extinguisher media chamber. If the cartridge is mounted inside the media chamber, this information shall be stencilled or stamped on the cartridge.

10.2.1.8 The marking on each extinguisher shall include its exact gross mass or minimum and maximum gross mass, which may be expressed by a tolerance. The gross mass shall include the mass of the charged extinguisher and discharge assembly.

10.2.1.9 The marking on each extinguisher shall include the following:

a) for extinguishers and brackets passing the vibration test of 7.5.2.5.2: “Suitable for general use only with bracket XXXXX”.

b) for extinguishers and brackets passing the vibration test of 7.5.2.5.3: “Suitable for use with bracket XXXXX”.

10.2.2 Operating instructions

10.2.2.1 For the purpose of applying the requirements of 10.2.2, the “operating instructions” are defined as those necessary to accomplish the intended discharge of the extinguishing medium, including any warnings. An example of the layout marking is given in Figure 9.

10.2.2.2 Clean agent fire extinguishers shall contain the following warning or equivalent as part of the operating instructions:

“WARNING — The concentrated agent, when applied to the fire, can produce toxic by-products. Avoid inhalation of these materials by evacuating and ventilating the area. Do not use in confined spaces of less than X cubic metres per extinguisher.”

NOTE X is the volume, expressed in cubic metres according to Equation (4).

$$X = \frac{WS100 - C}{C} \tag{4}$$

where

$$W = \frac{V}{S}\frac{C}{100 - C}$$

V is the volume occupied by 1 kg of vapour;

W is the mass of the clean agent, expressed in kilograms;

S is the specific volume of the agent at 60 °C, expressed in cubic metres per kilogram;

C is the LOAEL clean agent concentration, expressed as a percentage volume fraction.

10.2.2.3 The operating instructions shall face outward and cover no more than a 120° arc on the extinguisher body. The marking required in 10.2.2.4 and 10.2.3 shall together occupy a minimum surface area of 75,0 cm^2 for an extinguisher having a diameter greater than 80,0 mm and 50,0 cm^2 for and extinguisher having a diameter of 80,0 mm or less.

10.2.2.4 The operating instructions shall be arranged as follows.

a) The word “INSTRUCTIONS” shall be at the top of the nameplate. The minimum letter height shall be 6,0 mm for an extinguisher having a diameter greater than 80,0 mm and 5,0 mm for an extinguisher having a diameter of 80,0 mm or less. As an option, the words “FIRE EXTINGUISHER” or “EXTINGUISHER” may be added to the word “INSTRUCTIONS”.

b) The operating instructions shall be in the form of numerically sequenced pictographs. A single pictograph may include two instructions.

c) The sequence of pictographs shall illustrate, with pictures, the recommended actions necessary for intended operation of the extinguisher. Words may be added. The sequence shall be as follows:

    1) making the extinguisher ready by disengaging the safety-locking device,

    2) aiming the extinguisher at the base of the fire, including the recommended distance from the fire at which to begin discharge, and indicating the intended operating attitude of the extinguisher,

    3) taking whatever action necessary to initiate operation of the extinguisher,

    4) describing the intended method of applying the extinguishing medium on the fire.

10.2.2.5 The height of the words when used in the pictographs shall be least 3,0 mm high.

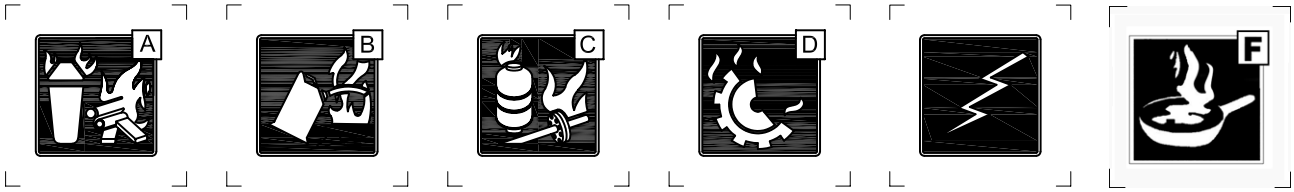
10.2.3 Use-code symbols

10.2.3.1 Use-code symbols (see Figure 10) shall be positioned directly below the operating instructions. A written description for each use-code symbol may be included as part of the code in letters having a minimum height of 1,0 mm.

10.2.3.2 The use-code symbols shall have dimensions no less than 16 mm × 16 mm and no more than 32 mm × 32 mm, excluding the borders.

10.2.3.3 Use-code symbols shall be placed on the extinguisher for those types of fires for which the extinguisher is classified and has shown to be suitable for use. For those classes of fires for which the extinguisher is not intended for use because of potential injury to the operator, the use-code symbols with a red slash shall also be placed on the extinguisher. The red slash shall be from the top left corner of the symbol to the bottom right corner.

10.2.3.4 The manufacturer's name or trade name may be placed below the use-code symbols, but shall not contain any other information that would distract attention from the operating instructions, such as an address or telephone number.



a) **b)** **c)** **d)** **e)** **f)**

a) class A: Ordinary solid material fires
b) class B: Flammable liquid fires
c) class C: Gas and vapour fires
d) class D: Combustible metal fires
e) fire involving energized electrical conductors
f) class F: Cooking oil fires

Figure 10 — Use-code symbols

10.2.4 Recharging instructions

The recharging instructions on the marking of a rechargeable extinguisher shall state the intended mass and agent that shall be used in recharging, the intended expellant gas pressure or the use of a correct and a fully charged gas cartridge. Reference shall be made to use only the manufacturer's replacement parts in recharging the extinguisher. However, in lieu of detailed recharge instructions, these instructions may simply instruct the user to return the extinguisher to the dealer or manufacturer for recharging, using the following words or the equivalent: "Return to an authorized recharger for recharging in accordance with Service Manual No. ...".

10.3 Inspection instructions

The inspection instructions shall state that the extinguisher shall be checked to ensure that

a) the seals and tamper indicators are not broken or missing;

b) it is full (by weighing or lifting);

c) it is not obviously damaged, corroded or leaking and does not have a clogged nozzle;

d) its pressure gauge reading or indicator is in the operable range or position.

11 Manuals

11.1 User manual

A user manual shall be provided with each extinguisher. This manual shall contain the necessary instructions, warnings and cautions for the intended installation, operation and inspection of the extinguisher. The manual shall also reference the manufacturer's service manual for maintenance and recharging of the extinguisher.

11.2 Service manual

The manufacturer shall prepare a service manual for each model fire extinguisher. It shall be made available upon request and shall

a) contain necessary instruction, warnings and cautions, a description of servicing equipment and a description of recommended operations for intended servicing;

b) provide a list of part numbers for all replaceable parts;

c) indicate that the pressure gauge attached to the extinguisher shall not be used to determine when the intended service pressure has been reached, and a pressure regulator shall be used if the pressure service is a tank of high-pressure gas.

Annex A
(normative)

Alternate test fire for powder extinguishers with a rating exceeding 144B

A.1 General

This is an alternative test method of evaluating an extinguisher with a powder medium having a rating that exceeds 144B. The method uses a small test fire model and two (2) small extinguishers containing the same extinguishing medium as that of an evaluation sample to find out their discharge rates and extinguishing times and, then, solving a series of mathematical equations to determine the rating of the sample as shown in the flow diagram in Figure A.1.

A.2 Test method

A.2.1 Determination of the coefficients of a, b, c, and d

A.2.1.1 Determination of the discharge rates R_1 and R_2

The discharge rates of the medium from an extinguisher through a smaller nozzle and a larger nozzle are designated R_1 and R_2, respectively. The discharge rate of the nozzle, expressed in kilograms per second, is measured in accordance with the procedures described in A.2.1.1.

The test to determine discharge rates of two different extinguishers, one with R_1 nozzle and the other with R_2 nozzle, uses two of each of the extinguishers designated in A.2.1.2 for determination of extinguishing times. Measure and record the mass of each extinguisher before discharge.

Conduct the following tests to determine rates of R_1 and R_2 by using two (2) extinguishers, one equipped with an R_1-rated nozzle and the other equipped with an R_2-rated nozzle.

For the first extinguisher, discharge the medium for approximately 1/3 of its total discharge time. Measure and record the mass of the extinguisher.

For the second extinguisher, discharge the medium for approximately 2/3 of its total discharge time. Measure and record the mass of the extinguisher.

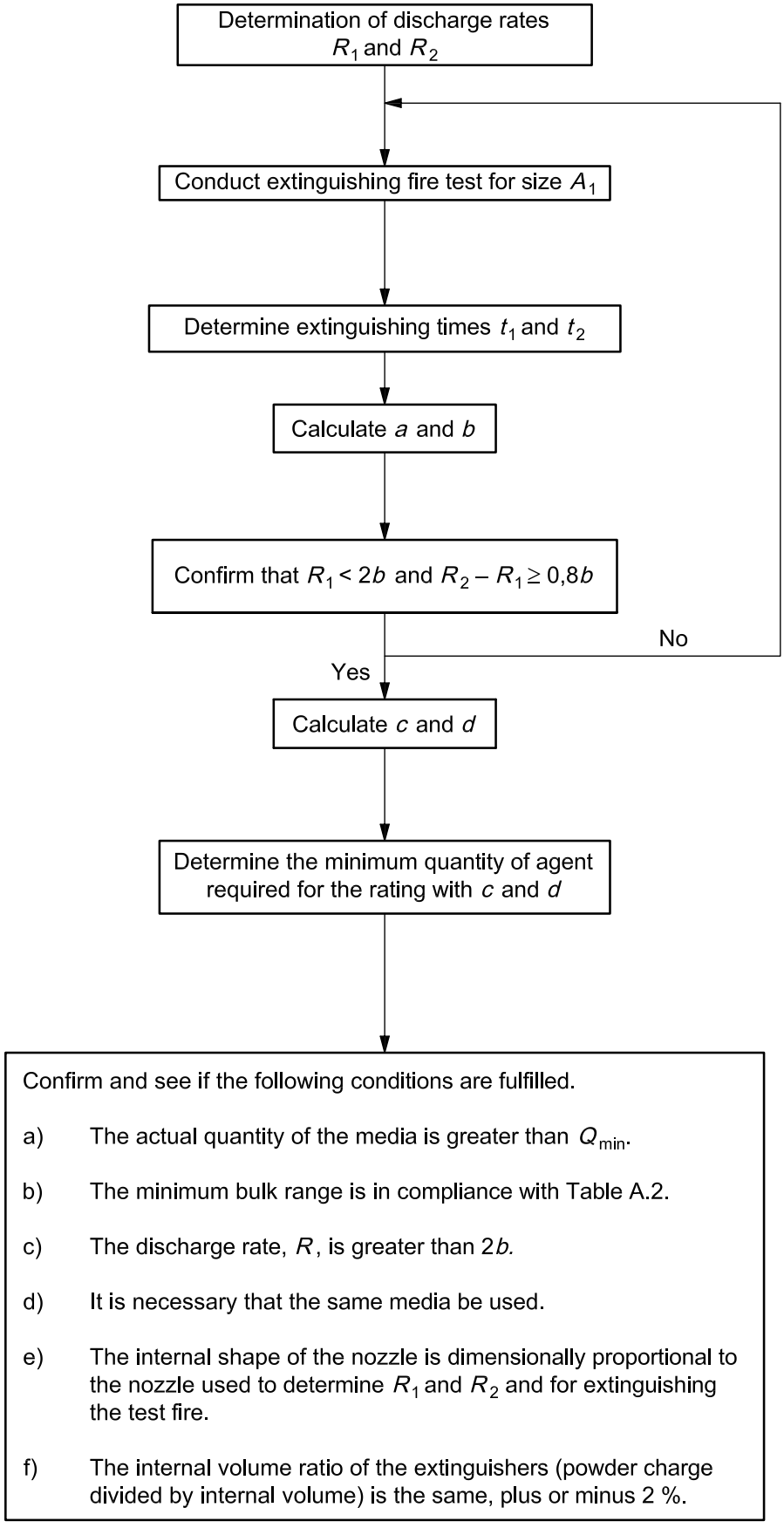


Figure A.1 — Alternative test method of evaluating an extinguisher with a powder medium having a rating that exceeds 144B

The discharge rate, R, expressed in kilograms per second, which is the mass change per unit time, can be calculated by dividing the difference of the post-discharge mass of the first and second extinguishers by the difference in the actual discharge time between the two extinguishers, as given by Equation (A.1):

$$R = \frac{M_2 - M_1}{t_t} \tag{A.1}$$

where

M_1 is the mass of the pre-discharged extinguisher remaining after subtracting the mass of the post-discharged extinguisher that operated for a duration of about 1/3 of the total discharge time;

M_2 is the mass of the pre-discharged extinguisher remaining after subtracting the mass of the post-discharged extinguisher that operated for a duration of about 2/3 of the total discharge time;

t_t is the actual time required for the 2/3 discharge subtracted from the actual time required for the 1/3 discharge.

When using extinguishers of different sizes to determine the two points, R_1 and R_2, for discharge rates, they shall have the same internal volume ratio of the extinguishing medium to cylinder volume, $\pm$ 2 %.

The nozzles for discharge rates, R_1 and R_2, shall have similar shapes. Furthermore, the nozzle diameters shall be such that $R_2 - R_1$ is equal to or greater than 0,8b.

A.2.1.2 Determination of extinguishing times of t_1 and t_2

Measure the extinguishing times, t_1 and t_2, for two (2) extinguishers, one with R_1 discharge rate and the other with R_2 discharge rate, respectively. The extinguishing times, t_1 and t_2, expressed in seconds, are defined as a time required to extinguish a fire by using an extinguisher with an R_1 and an R_2 discharge rate, respectively.

The extinguishing time shall fall between 1/3 and 2/3 of the total discharge time.

A.2.1.3 Determination of coefficients

A.2.1.3.1 Coefficients a and b

The coefficients a and b are calculated from the extinguishing times, t_1 and t_2, and the discharge rates, R_1 and R_2, as given in Equations (A.2) and (A.3):

$$t_1 = \frac{aR_1}{(R_1 - b)} \tag{A.2}$$

$$t_2 = \frac{aR_2}{(R_2 - b)} \tag{A.3}$$

EXAMPLE 1 Data from the 144B fire tests are as follows:

R_1 = 0,41 kg/s, t_1 = 8,6 s, R_2 = 0,56 kg/sec, t_2 = 7,3 s.

In this case, a = 5,17, b = 0,16.

If R_1 is less than 2b, repeat this fire test with a large nozzle with different discharge rate until the values of $R_1 > 2b$ and $R_2 - R_1 \geqslant 0{,}8b$.

EXAMPLE 2 In the case of R_1 = 0,41 kg/s, 2b = 0,32, $R_1 > 2b$, R_2 = 0,56, R_1 = 0,41. The value of $R_2 - R_1$ is equal to or greater than 0,8b. Therefore, there is no need to repeat the test.

A.2.1.3.2 Coefficients c and d

Determine the coefficients c and d from Equations (A.4) and (A.5):

$$c = a \Big/ A_1^{0,5} \tag{A.4}$$

$$d = b \Big/ A_1^{0,75} \tag{A.5}$$

where A_1, the test fire size, is determined from Table A.1.

EXAMPLE With a = 5,17 and b = 0,16 from A.2.1.3.1, Example 1, and A_1 = 4,52 m^2, c = 2,43, d = 0,05.

A.2.2 Assignment of fire rating

A.2.2.1 Minimum quantity of powder required

The values of a' and b' for evaluated rating shall be calculated from Equations (A.6) and (A.7).

$$a' = cA_2^{0,5} \tag{A.6}$$

$$b' = dA_2^{0,75} \tag{A.7}$$

where A_2, the area for the assigned rating, is determined from Table A.1.

EXAMPLE For an assigned rating of 377B, with c = 2,43 and d = 0,05 from the example in A.2.1.3.2, and A_2 = 11,9 m^2 from Table A.1, a' = 8,38, b' = 0,32.

Q_{min}, the minimum amount of extinguishing powder media required to extinguish a class B fire, shall be calculated from Equation (A.8).

$$Q_{\text{min}} = \frac{2a'R^2}{\left(R - b'\right)} \tag{A.8}$$

where R is the discharge rate of the prototype extinguisher and a' and b' are calculated from Equations (A.6) and (A.7).

A.2.2.2 Assignment of prototype extinguisher's fire rating

The discharge rate of the prototype extinguisher, R, shall be measured according to A.2.1.1. The assigned rating shall be given to the prototype extinguisher if the following conditions are fulfilled:

a) The charge of the extinguisher is more than Q_{min} on the Guise curve.

b) The minimum bulk range shall be as shown in Table A.2.

c) The discharge rate, R, of the extinguisher is larger than $2b'$.

d) The extinguishing medium shall be the same used in A.2.1.

e) The internal shape of the nozzle used on the prototype extinguisher shall be dimensionally proportional to the nozzle used for determining R_1 and R_2 and for extinguishing the test fire.

f) The internal volume ratio (powder charge divided by internal volume) shall be the same as the test extinguisher, plus or minus 2 %.

Table A.1 — Fire test size

Test fire size	A_1 m^2	Assigned rating	A_2 m^2
89B	2,80	183B	5,75
		233B	7,32
144B	4,52	296B	9,32
		377B	11,9

Table A.2 — Minimum bulk range

Assigned rating	Minimum bulk range M
183	3,6
233	
296	4,7
377	

Bibliography

[1] ANSI/UL 1439, *Safety Standard for the Determination of Edges on Equipment*

[2] Compressed Gas Association (CGA) pamphlet C-1, section 1.0

ICS 13.220.10

Price based on 58 pages