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Fire fighting — Wheeled fire extinguishers — Performance and construction

Lutte contre l'incendie — Extincteurs sur roues — Performances et construction

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Foreword

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

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

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

ISO 11601 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 11601:1999), which has been technically revised.

Fire fighting — Wheeled fire extinguishers — Performance and construction

1 Scope

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

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 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 3768, *Metallic coatings — Neutral salt spray test (NSS test)*

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

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

ISO 7201-1, *Fire protection — Fire extinguishing media — Halogenated hydrocarbons — Part 1: Specifications for halon 1211 and halon 1301*

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

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

ISO 7203-2, *Fire extinguishing media — Foam concentrates — Part 2: Specification for medium and high expansion foam concentrates for top application to water-immiscible liquids*

ISO 14520-1, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 1: General requirements*

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
body
metal shell of an extinguisher designed to contain the extinguishing media including any skirt

3.3
bulk range
discharge range of an extinguisher when 50 % of its extinguishing medium has been expelled with the discharge valve fully open

3.4
burst pressure
P_b
pressure at which the extinguisher cylinder ruptures

3.5
charge of extinguisher
mass or volume of extinguishing medium contained in the extinguisher expressed in volume (litres) for water-based extinguishers and in mass (kilograms) for other extinguishers

3.6
classification of fires

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

Class B fires involving liquids or liquefiable solids

Class C fires involving gases

Class D fires involving metals

3.7
clean agent
electrically non-conductive gaseous or vaporizing liquid fire-extinguishing medium that does not leave a residue upon evaporation

3.8
closure
component, other than a safety device or pressure indicator, subject to internal pressure and used to close off and seal the body

3.9
complete discharge
point in the discharge of an extinguisher when the internal pressure has equalized with the external pressure with the control valve being kept fully open

3.10
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

3.11
extinguisher
appliance containing an extinguishing medium which may be discharged and directed onto a fire by the action of internal pressure

NOTE Discharge may be achieved by

a) stored pressure (constant pressurization of the extinguishing media container), or

b) cartridge or cylinder operated device (pressurization at the time of use by the release of a pressurizing gas stored in a separate high-pressure cartridge or container)

3.12
extinguishing medium
substance contained in the extinguisher which causes extinction

3.13
fill density
mass in kilograms of extinguishing medium per litre of container volume as fitted for use, complete with valve and internal fittings

3.14
gas point
point where the medium discharge changes from predominately medium to predominately expellant gas

3.15
lowest observable adverse effect level
l.o.a.e.l.
the lowest concentration at which an adverse physiological or toxicological effect has been observed

3.16
maximum service pressure
P_{ms}
equilibrium pressure developed in a normally charged and pressurized extinguisher which is conditioned at 60 °C for at least 18 h

3.17
propellant
non-flammable compressed gas used to expel the extinguishing medium

3.18
rechargeable extinguisher
extinguisher designed and intended to be recharged after use

3.19
service pressure
P_s
equilibrium pressure developed in a normally charged and pressurized extinguisher conditioned at 20 °C for at least 18 h

3.20
test pressure
P_t
for low-pressure wheeled extinguishers, P_t is the higher of $1{,}43 \times P_{ms}$, $2{,}5 \times P_s$ or 2,0 MPa

3.21
wheeled fire extinguisher
appliance on wheels having a total mass more than 20 kg but not greater than 450 kg, which is designed to be operated and transported to the fire by one person

4 Types of wheeled fire extinguishers

4.1 General

4.1.1 Wheeled fire extinguishers are described by the type of extinguishing medium which they contain. At present, the types of wheeled fire extinguishers are:

— water-based;

— powder;

— carbon dioxide;

— clean agent.

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

4.1.2 Water-based wheeled fire extinguishers may contain plain water, or water with additives such as wetting agents, viscosity-increasing agents, or flame-retardant or foaming agents.

NOTE Currently there are no ISO International Standards covering additives added to water to produce antifreeze, wetting or other special characteristics.

4.1.3 Powders may be of the "BC" or "ABC" types, or may be specially prepared for Class D fires.

4.1.4 Wheeled fire extinguishers may have two extinguisher bodies per axle. Each extinguisher body may contain the same or a different extinguishing medium provided they are compatible with each other.

5 Extinguishing media, propellants and fill densities

5.1 Extinguishing media

5.1.1 Carbon dioxide

Carbon dioxide used in wheeled fire extinguishers shall comply with ISO 5923.

5.1.2 Clean agents

Clean agents used in wheeled fire extinguishers shall comply with ISO 7201-1 (alternatively, ISO 14520-1).

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

5.1.3 Powder

Powder used in wheeled fire extinguishers shall comply with ISO 7202.

IMPORTANT — Exception: powders for use on Class D fires.

5.1.4 Foam concentrates

Foam concentrates used in wheeled fire extinguishers shall comply with ISO 7203-1 (alternatively, ISO 7203-2).

5.2 Propellants

The propellant for stored pressure and cartridge-operated wheeled fire extinguishers shall be air, argon, carbon dioxide, helium, nitrogen or mixtures of these gases having a maximum dewpoint of − 60 °C.

IMPORTANT — Exception: propellant for stored pressure water-based wheeled fire extinguishers need not meet the dewpoint requirement.

5.3 Fill density

The fill density for carbon dioxide wheeled fire extinguishers shall not exceed 0,75 kg/l.

The fill density for clean agent wheeled fire extinguishers shall not exceed the values given in ISO 7201-1 (alternatively, ISO 14520-1).

NOTE These fill densities may be modified subject to national pressure vessel regulations.

5.4 Filling tolerance

The actual charge of a wheeled fire extinguisher shall be the nominal charge within the following limits:

a) water-based extinguishers: +0, −5 % by volume;

b) powder-based extinguishers: ± 2 % by mass;

c) carbon dioxide and clean agent extinguishers: +0, −5 % by mass.

5.5 Charges

5.5.1 Nominal charge

The following are the recommended charges for wheeled fire extinguishers:

a) water-based extinguishers: 20 l, 45 l, 60 l and 125 l;

b) powder-based extinguishers: 20 kg, 50 kg, 100 kg and 150 kg;

c) carbon dioxide and clean agent extinguishers: 10 kg, 20 kg, 30 kg and 50 kg.

NOTE Other nominal capacities are allowed.

5.5.2 Gross weight

The gross weight of a wheeled fire extinguisher shall not exceed 450 kg.

6 Performance

6.1 Operating temperatures

Wheeled fire 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

NOTE The temperature range selected from the above ranges shall be marked on the extinguisher (see 9.2.5).

6.2 Effective discharge time and bulk range of discharge

6.2.1 Effective discharge time

6.2.1.1 The effective discharge time of water-based type wheeled fire extinguishers shall be not less than 40 s or more than 210 s.

6.2.1.2 The effective discharge time of wheeled fire extinguishers with a Class A rating, except water-based types, shall be not less than 30 s.

6.2.1.3 The effective discharge time of wheeled fire extinguishers other than water-based types shall be not less than 20 s.

6.2.2 Bulk range

6.2.2.1 The bulk range of wheeled fire extinguishers with a Class A rating shall be not less than 6 m when tested in accordance with 6.2.2.2.

IMPORTANT — Exception: for water-based type wheeled fire extinguishers fitted with a spray nozzle, the bulk range maybe reduced to 3 m.

6.2.2.2 Condition the extinguisher for not less than 18 h at a temperature of (20 ± 3) °C and place it in its normal operating position with the discharge nozzle held horizontally at a height of 1 m.

Fully discharge the extinguisher with the control valve fully open within 5 min of conditioning.

Record the bulk range at the time corresponding to 50 % of the effective discharge time.

NOTE If the range of effective discharge is difficult to determine visually, supplementary means, such as collection boxes for water, foam or powder extinguishers or condensing plates for carbon dioxide and clean agent extinguishers may be used.

6.3 Resistance to temperature changes

6.3.1 Requirements

Wheeled fire extinguishers shall be able to operate at temperatures between the minimum marked on the extinguisher (see 6.1) and +60 °C. After the test described in 6.3.2, they shall satisfy the following requirements:

a) the extinguisher shall operate as intended;

b) the extinguisher shall commence discharge within 5 s of the control valve being opened;

c) not more than 10 % of the initial charge of media shall remain within the extinguisher after complete discharge.

6.3.2 Test procedure

Subject four extinguishers to the temperature cycles defined in Table 1, two extinguishers to each cycle.

Table 1 — Temperature cycles

Duration h	Cycle No. 1	Cycle No. 2[a]
24 ± 1	Store at minimum storage[a] and use temperature (+0, −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 storage and use temperature (+0, −2) °C
[a] The storage temperatures refer to the ambient temperature within the conditioning chamber.		

Operate the extinguisher with the control valve fully open within 5 min of its removal from the conditioning chamber.

NOTE If it is not possible to operate the extinguisher within 5 min after its removal from the conditioning chamber, suitable means, such as insulation shall be used to maintain the extinguisher at the conditioning temperature until discharge.

6.4 Retention of charge

6.4.1 Checking

6.4.1.1 Wheeled fire extinguishers and gas cartridges or cylinders shall be designed so as to permit their charge to be checked at regular intervals when they are installed.

6.4.1.2 The charge of the following types of wheeled fire extinguishers shall be measured by weighing:

a) all types of gas cartridges for wheeled fire extinguishers;

b) carbon dioxide wheeled fire extinguishers;

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

6.4.1.3 The charge of stored pressure wheeled fire extinguishers of types not covered by 6.4.1.2 b) and 6.4.1.2 c) and non-liquefied gas containers fitted with a gauge shall be checked by direct measurement of internal pressure at (20 ± 2) °C. For this purpose, the extinguisher shall be fitted with a pressure gauge ported into the extinguisher body.

NOTE If a connection is provided to which an independent pressure measuring appliance can be attached for checking the pressure gauge, the connection is equipped with a pressure retaining cap.

6.5 Intermittent discharge test

6.5.1 A wheeled fire extinguisher conditioned at (20 ± 5) °C and at (60 ± 2) °C shall operate in such a manner that not more than 1 s elapses from the time the control valve is operated until the extinguishing medium starts to discharge and shall cease the discharge of medium within 1 s after closing the control valve. Not more than 10 % of the initial charge remains within the extinguisher after complete discharge.

6.5.2 The test shall be conducted following conditioning at each of the temperatures specified in 6.5.1 for at least 18 h. The extinguisher shall be operated intermittently by opening and closing the control valve in cycles of 5 s open and 5 s closed until the end of discharge.

6.6 Resistance to corrosion

6.6.1 External corrosion test

Wheeled fire extinguishers shall be subjected to a salt spray test as defined in ISO 3768 for a period of 480 h and then shall be washed carefully to remove any salt deposits. Two samples shall be tested, either two of the same size or one sample each of two different sizes from the same family.

The operating forces, or energy if applicable, shall comply with the method of operation specified in 8.14.

The pressure gauge on stored pressure extinguishers shall remain watertight and functional. See 8.16.7.

There shall be no corrosion of the metal of the extinguisher likely to impair its operation or safety. Discolouration or superficial corrosion of non-ferrous materials is acceptable but galvanic corrosion between dissimilar metals is not permitted.

Test samples employing smaller extinguisher bodies are permitted to be used for this test provided they are fabricated using the same material and processes and have the same protective coatings or corrosion protection system.

The length of the discharge hose assembly is permitted to be reduced to 1,4 m for this test.

6.6.2 Internal corrosion test for water and foam extinguishers

Wheeled fire extinguishers, charged in accordance with the manufacturer's instructions, shall be subjected eight times to the temperature cycle defined in Table 2.

Table 2 — Temperature cycles

Stage	Duration h	Conditioning chamber temperature °C
1	(24 ± 1)	[a]
2	(⩾ 24)	(20 ± 5)
3	(24 ± 1)	(60 ± 5)
4	(⩾ 24)	(20 ± 5)

[a] Lowest temperature marked on extinguisher, (± 5) °C. See 6.1.

Test samples employing smaller extinguisher bodies are permitted to be used for this test provided they are fabricated using the same material and processes and have the same protective coatings or corrosion protection system.

A liquid bath shall not be used.

The duration of any one complete cycle shall not exceed 120 h.

On completion of the eight temperature cycles, the body shall be cut into two sections in a manner sufficient to permit internal examination. Detachment of any protective coating local to the plane of section shall be disregarded. There shall be no visible signs of corrosion of the metal or 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.

NOTE In order to establish reference samples for a change of colour that occurs naturally due to the temperature changes, two samples of the extinguishing medium shall be stored in closed glass containers and subjected to the same cycles as the extinguishers.

6.7 Durability test

6.7.1 After being subjected to the series of tests described in 6.7.2 through 6.7.4, a fully charged wheeled fire extinguisher shall comply with the following:

— not less than 85 % (by weight) of the rated capacity of the extinguishing medium shall be discharged as intended;

— the wheels, axles, and carriage assembly shall not be damaged to the extent of impairing mobility by one person;

— no weld shall be broken;

— the dip tube shall not become dislodged.

6.7.2 Durability shall be evaluated by:

— being pushed or pulled for 8 km at the rate of 8 km/h to 13 km/h over a rough surface;

NOTE A surface of crushed stone, nominal size of 18 mm or equivalent, is considered a rough surface.

— being dropped three times onto a concrete surface from a 300 mm high platform so as to land on the wheels;

— being pulled at a speed of 8 km/h and allowing one wheel to strike a vertical wall of concrete, steel, or brick; and

— being pushed over so as to land on the bumper or towing handle.

6.7.3 Drop the nozzle of a wheeled extinguisher, as attached to the hose, three times onto a concrete surface from a height of 900 mm. The assembly is to be dropped in a random manner so that no effort is made to cause any part of the nozzle, such as the tip or handle, to initially strike the concrete surface.

6.7.4 A wheeled fire extinguisher, when placed in its intended storage position on a flat concrete surface, shall be self-supporting, stable, able to return to the storage position when displaced from its vertical position by 10° and operable.

6.8 Electrical conductivity of extinguisher discharge

6.8.1 Requirement

Water-based wheeled fire extinguishers that are marked as being suitable for use on fires involving energized electrical equipment shall not pass a current of more than 0,5 mA when tested as described in 6.8.2.

6.8.2 Procedure used to test for electrical conductivity

Hang a metal plate, of dimensions (1 m × 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 earth. In the case of an extinguisher with a

hose, connect it to earth by connection at the nozzle or in the case of an extinguisher not fitted with a hose, by connection at the handle.

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

7 Fire performance tests

7.1 Suitability for the various classes of fire

7.1.1 Class A. The rating of wheeled fire extinguishers recommended as suitable for Class A fires shall be determined using the method of 7.2. The rating shall be that of the maximum fire size extinguished under the conditions of the test.

7.1.2 Class B. The rating of extinguishers recommended as suitable for Class B fires shall be determined using the method of 7.3. The rating shall be that of the maximum fire size extinguished under the conditions of the test.

7.1.3 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 fires may be claimed for Class AB or B powder-based extinguishers only.

7.1.4 Class D. Wheeled extinguishers recommended as suitable for Class D fires shall comply with 7.4.

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

7.2 Class A fire tests

Wheeled fire extinguisher intended for use on Class A fires shall be tested for a minimum Class A fire rating of 4-A using the Class A rating system specified in ISO 7165.

7.3 Class B fire tests

Wheeled fire extinguishers intended for use on Class B fires shall be tested for a Class B fire rating using the Class B rating system specified in ISO 7165.

NOTE A method of rating wheeled extinguishers for Class B ratings greater than 144B based upon discharge characteristics and fire tests not exceeding 144B is under development.

7.4 Class D fire tests

The extinguishment of fires should be carried out using a portable extinguisher in accordance with ISO 7165.

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

Since wheeled fire extinguishers have a greater charge, they may be classified for use on a proportionally larger quantity and/or surface area of Class D combustible metals without repeating the Class D fire tests.

8 Construction requirements

8.1 General requirements

8.1.1 The test shall be carried out on a minimum of three extinguisher bodies. For stored pressure extinguishers, the pressure shall be determined immediately after conditioning each extinguisher at (60 ± 3) °C for 18 h. The highest of the pressures is designated P_{ms}. For cartridge or cylinder operated type extinguishers, after conditioning at (60 ± 3) °C for 18 h, the cartridge or cylinder shall be immediately activated, and the highest pressure recorded as P_{ms}.

8.1.2 It shall be verified that, during the temperature conditioning specified in 8.1.1, there is no leakage from the extinguisher, gas cartridge or cylinder.

8.1.3 The manufacturer shall take the necessary steps to ensure that 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 or cartridge. The manufacturer shall use welders, welding operators and welding procedures which can be demonstrated to be suitable for the purpose.

NOTE Users of this International Standard should consider the use of conformity assessment methods relevant to the needs of this International Standard. Certification by an independent third party can provide a higher level of confidence in the conformity of products, people and processes.

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

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

8.1.6 Consideration shall be given to avoid the possibility of cross threading plastic components in contact with metallic parts. Such consideration shall include the use of coarse threads, etc.

8.2 High-pressure cylinders

Wheeled fire extinguishers or propellant gas cartridges and cylinders having P_s greater than 2,5 MPa shall be fitted with cylinders, valves and pressure gauges which are designed, tested and marked in accordance with national regulations.

8.3 Low-pressure cylinders

8.3.1 General

The following requirements apply to wheeled fire extinguisher bodies having P_s not exceeding 2,5 MPa at (20 ± 3) °C.

8.3.1.1 Burst test

8.3.1.1.1 The cylinder is to be filled with a suitable liquid and the pressure shall be increased at a rate not exceeding (2,0 ± 0,2) MPa/min until bursting occurs. The minimum P_b shall be 2,7 × P_{ms}, or 5 × P_s, whichever produces the highest P_t, but in no case less than 5,5 MPa.

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

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

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

8.3.1.1.5 The break shall not occur in a weld at a pressure less than $5{,}4 \times P_{ms}$ or 8 MPa, whichever is greater.

8.3.1.1.6 During the burst test, no parts shall be ejected from the extinguisher.

8.3.1.2 Deformation test

There shall be no permanent expansion in excess of 10 % of the total expansion when a previously untested cylinder is subjected to P_t, applied for 30 s. For cylinders which have been subjected to P_t, P_t shall be increased by 10 %.

NOTE An acceptable test apparatus is the water jacket test as described in the Compressed Gas Association (CGA) pamphlet C-1. Other appropriate test methods are also acceptable.

8.4 Steel cylinders

8.4.1 Welded low-carbon steel

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

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

8.4.2 Stainless steel cylinders

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

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

8.5 Aluminium cylinders

Aluminium cylinders shall be of a seamless construction.

8.6 Minimum wall thickness

Cylinders shall have a minimum measured wall thickness, t, in millimetres, greater than the minimum wall thickness given by Equation (1), but in no case less than 2,0 mm:

$$t = \frac{D(P_t)}{2S} \tag{1}$$

where

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

P_t is the cylinder test pressure, MPa;

S is 80 % of the minimum yield strength of the material specified by the manufacturer, N/mm^2.

8.7 Caps, valves and closures

8.7.1 Wheeled fire extinguisher cylinder caps, valves and closures shall be designed to provide release of pressure before complete disengagement.

8.7.2 All threaded connections shall have at least four full threads of engagement and be required to relieve pressure with at least two full threads of engagement.

8.7.3 The inside diameter of a fill opening for a wheeled extinguisher shall be not less than 50 mm for powder types and 19 mm for other types.

IMPORTANT — Exception: the size of the fill opening can be reduced to 25 mm for powder extinguishers having a charge not exceeding 50 kg.

8.7.4 A wheeled extinguisher collar with external threads shall have sufficient height so that the cap or valve does not come into contact with the dome or bottom with the gasket removed.

8.7.5 A cap, valve or closure shall withstand the burst test pressure of the cylinder for 1 min without rupture. For this test, remove or plug pressure relief devices.

8.7.6 The edges and surfaces of a wheeled fire extinguisher 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 the sharpness of edges is described in ANSI/UL 1439. Other equivalent methods are acceptable.

8.8 Safety and anti-overfill devices

8.8.1 Safety devices

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

8.8.1.2 There are no compulsory safety devices required on low-pressure cylinders. However, if such a device is used, it must be appropriately sized and positioned. The operating pressure of the device shall not exceed P_t nor be less than P_{ms}.

8.8.2 Anti-overfill devices

A water-based wheeled fire extinguisher shall be provided with a device to insure that the extinguisher can not be overfilled. As an alternative, the extinguisher body may be marked with the words “FILL MARK” or “FULL” to indicate the maximum liquid level.

8.9 Manufacturing tests

8.9.1 Low-pressure cylinders

8.9.1.1 At least one cylinder from each batch of 500 or less shall be subjected to the deformation and burst tests. At the option of the manufacturer, the deformation and burst test may be conducted on the same cylinder. If the test results are not acceptable, five additional cylinders are to be randomly selected from the same batch and repeated. If one of the cylinders does not pass the test, the batch is rejected and made unserviceable.

As an alternative, non-destructive tests such as X-ray or ultrasonic devices are permitted to be substituted for the burst test if it can be demonstrated that they provide an equivalent level of assurance that the cylinders comply with the burst test requirements.

8.9.1.2 Each cylinder shall be subjected to P_t, for at least 30 s, without leakage, failure or visible deformation.

8.9.2 Leakage tests

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

a) For stored pressure wheeled fire extinguishers and cylinders fitted with a pressure gauge as specified in 6.4.1.2, the rate of leakage shall not exceed a rate of loss of pressurizing content equivalent to 5 % per annum of the service pressure.

b) For gas cartridges and cylinders, carbon dioxide and stored pressure type wheeled extinguishers specified in 6.4.1.1, the rate of leakage shall not exceed a rate equivalent to a 5 % loss of content per annum.

8.9.2.2 When put under pressure with the control valve closed, wheeled fire extinguishers shall not show a loss of pressure greater than 10 % of the service pressure within 15 min. This requirement also applies to hoses fitted with a control valve which are put under pressure only when used.

8.10 Requirements for plastic components

8.10.1 General requirements

8.10.1.1 Plastic components of wheeled fire extinguishers shall comply with the following requirements. The test and conformity checks shall be carried out on components which correspond to the mass produced components in respect of the material used, the form and the method of manufacture.

8.10.1.2 It is recommended that the plastic used shall be identifiable at all times. Any change in the material, the form, or the method of manufacture requires a new test.

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

8.10.1.4 To verify the attachment of plastic parts following the air oven aging, ultraviolet light exposure and impact resistance tests, the plastic part(s) is/are to be attached to an extinguisher and the assembly then subjected to the appropriate test(s).

8.10.2 Requirements for normally pressurized components

8.10.2.1 Burst strength

8.10.2.1.1 Burst tests at three temperatures shall be conducted as described below:

At least three components shall be burst tested using an appropriate liquid at temperatures of (20 ± 3) °C, the minimum temperature marked on the extinguisher ± 5 °C and at (60 ± 5) °C (see 6.1). The rate of increase in pressure shall be (2,0 ± 0,2) MPa/min.

8.10.2.1.2 The bursting pressure before and after the aging and ultraviolet light exposure test shall be at least equal to the minimum P_b.

8.10.2.2 Air oven aging

8.10.2.2.1 At least three components shall be subjected at an accelerated aging in an oven at (100 ± 3) °C for 180 d (4 320 h).

8.10.2.2.2 Following the exposure, the components shall then be conditioned for 5 h at (20 + 3) °C and subsequently inspected for cracking. No cracking shall be permitted.

8.10.2.2.3 The components shall then be burst tested at (20 ± 3) °C using a suitable liquid at a rate of pressure increase of (2,0 ± 0,2) MPa/min. P_b shall be at least equal to that specified for the extinguisher.

8.10.3 Ultraviolet light exposure

8.10.3.1 For external components, at least six samples shall be subjected for 500 h to an artificial weathering test in accordance with 8.10.3.3 and then conditioned for 5 h at (20 ± 3) °C. The samples shall then be inspected for cracking. No cracking shall be permitted.

8.10.3.2 The components shall then be burst tested at (20 ± 3) °C using a suitable liquid at a rate of pressure increase of (2,0 ± 0,2) MPa/min. P_b shall be at least equal to that specified for the extinguisher.

8.10.3.3 The ultraviolet light is to be obtained from two stationary enclosed carbon-arc lamps. The arc of each lamp is to be formed between two vertical carbon electrodes, 12,7 mm in diameter, located at the centre of a revolvable vertical metal cylinder, 787 mm in diameter and 450 mm in height. Each arc is to be enclosed with a clear borosilicate glass globe. The samples are to be mounted vertically on the inside of the revolvable cylinder continuously revolved around the stationary lamps at one revolution per minute. A system of nozzles is to be provided so that each sample, in turn, is sprayed with water as the cylinder revolves. During each operating cycle (total of 20 min) each sample is to be exposed to the light and water spray for 3 min and to the light only for 17 min. The air temperature within the revolving cylinder of the apparatus during operation is to be (63 ± 5) °C.

8.10.4 Normally non-pressurized components

8.10.4.1 Plastic wheeled fire extinguisher components which are only subject to pressure upon extinguisher operation shall be subjected to the burst, air oven aging and impact resistance tests. The air oven exposure is either (100 ± 3) °C for 70 d (1 680 h) or (87 ± 3) °C for 180 d (4 320 h) at the manufacturer's choice.

8.10.4.2 External plastic components shall comply with the ultraviolet light test specified in 8.10.3.

8.10.5 Exposure to extinguishing agent test

8.10.5.1 There shall be no damage to polymeric siphon tubes, which have been conditioned in accordance with 8.10.5.2 when installed in test extinguishers and subjected to the mechanical resistance test described in 6.7. Following conditioning in accordance with 8.10.5.2 ring samples cut from polymeric siphon tubes shall not exhibit degradation in excess of 40 % of the original tensile or ring crushing strength values.

8.10.5.2 Place complete siphon tubes in contact with the media with which they are to be used. Totally cover or immerse ring samples, 12,7 mm wide, cut from unaged siphon tubes in the media. Ensure the samples do not touch each other or the container holding the media and samples. Place the container of media, with the samples in place, in a preheated oven at (90 ± 3) °C for 210 d (5 040 h). 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 per minute 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.

8.11 Discharge assembly

8.11.1 Wheeled fire extinguishers shall be equipped with a hose at least 4,0 m long and a shutoff nozzle at the end of the hose to permit intermittent operation.

However, the minimum length of the discharge hose may be reduced to 1,5 m for wheeled extinguishers having a charge of extinguishing medium not exceeding 25 kg or 25 l.

8.11.2 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.

8.11.3 The burst pressure of the hose assembly shall be equal to or greater than the appropriate value below. P_t shall be established by increasing the pressure to the minimum allowable burst pressure in a time not less

than 30 s, maintaining that pressure for a further 30 s during which time failure must not occur and then increasing the pressure until the point of failure.

a) For all types except carbon dioxide wheeled extinguishers the burst pressure shall be equal to or greater than:

   — three times the pressure developed in the extinguisher at 60 °C, the test being carried out at (20 ± 5) °C;

   — twice the pressure developed in the extinguisher at 60 °C, the test being carried out at (60 ± 5) °C.

b) For carbon dioxide extinguishers the burst pressure shall be equal to or greater than:

   — 1,5 times the pressure developed in the extinguisher at 60 °C, the test being carried out at (20 ± 5) °C;

   — 1,25 times the pressure developed in the extinguisher at 60 °C, the test being carried out at (60 ± 5) °C.

8.12 Control valve

8.12.1 Wheeled fire extinguishers shall be fitted with a controllable valve at the discharge end of the hose assembly to permit discontinuance of the discharge of the extinguishing medium at any given time. Furthermore, the valve must be satisfactorily resistant to leakage following cessation of the discharge. This requirement shall be verified by the following test.

Operate the wheeled fire extinguisher for a period equal to half the time for total discharge and then close the valve.

In the case of a wheeled fire extinguisher with a gas cartridge, two situations may arise:

a) if the extinguisher is fitted with a pressurization device independent of the device which opens the controllable valve, the pressurization of the extinguisher is to take place 3 min before the controllable valve is opened;

b) if a single action pressurizes the extinguisher and releases the first emission of gas, the extinguisher is initially to be pressurized. After 3 min, the controllable valve is to be opened.

The internal pressure or, in certain cases, the weight, shall be measured within 10 s of the controllable valve having been closed and again after a duration of 5 min, the controllable valve having remained closed for that period.

The second value of pressure or weight shall not be less than 75 % of the first measured value. The test shall be carried out at (20 ± 3) °C.

8.13 Horn for carbon dioxide extinguisher

8.13.1 The horn of a carbon dioxide wheeled fire extinguisher shall be fitted with a handle to protect the hand of the operator against cooling during use.

8.13.2 The horn, after being subjected to a static load of 25 kg using a circular contact of 50 mm in diameter for 5 min, applied to the end of the horn, shall show no damage or deformation after 48 h.

8.13.3 The horn connection shall be made in such a manner as to prevent loosening or detachment.

8.13.4 If the connection is a screw thread, then it shall be secured against loosening by either mechanical means or a suitable adhesive.

8.13.5 When security is provided by mechanical means such as locknuts, lock washers, spring washers, etc., the torque to loosen the assembly shall be equal to or greater than 20 N·m. When adhesives are used the torque to loosen the assembly shall be equal to or greater than 10 N·m.

8.13.6 The discharge horn shall be subjected to the following test:

a) condition the horn at a temperature of (60 ± 5) °C for 18 h;

b) attach the horn to a fully charged extinguisher;

c) discharge the extinguisher with the control valve fully opened;

d) subject the horn to a static load of 25 kg using a circular contact surface of 50 mm in diameter for 5 mm applied to the extremity of the horn;

e) check that the horn does not show any defect.

8.14 Method of operation

8.14.1 Operate the wheeled extinguisher by piercing, opening and/or breaking a sealing device, and release its content. It shall not be necessary for any movement of the actuating mechanism to be repeated or to invert the extinguisher to initiate discharge of the extinguisher. The force or energy necessary to operate the extinguisher shall not exceed the values specified in Table 3 for temperatures up to 60 °C.

Table 3 — Operating force or energy

Type of device	Maximum required for operation	
	Force N	Energy J
Operating lever	300	—
Squeeze grip lever	300	—
Strike knob	—	3
Valve wheel	120	—

8.14.2 The force, which is to be measured using a dynamometer, shall be applied statically and perpendicularly at the normal location where force is applied to operate the extinguisher.

8.14.3 The energy of 3 J is obtained with a cylindrical steel weight with flat faces measuring 75 mm in diameter and weighing 4 kg. It shall be placed inside of a structure which will allow it to free fall vertically from a height of 75 mm. The impact must be applied in the normal direction used to operate the extinguisher.

8.15 Safety locking devices

The operating mechanism of a wheeled fire extinguisher shall be provided with a safety locking device to prevent inadvertent operation. The release of the safety device shall involve an operation distinct from that of the operation mechanism and shall require a force not less than 20 N or more than 100 N. It shall be possible to visually determine whether the extinguisher may have been operated.

8.16 Pressure gauges for low-pressure extinguishers

8.16.1 General

8.16.1.1 A wheeled fire extinguisher of the stored pressure type (except carbon dioxide) employing a single chamber for both the extinguishing media and the expellant gas shall be equipped with a pressure gauge to show the amount of pressure in the chamber whether the valve is opened or closed.

8.16.1.2 The operable pressure range of the gauge shall reflect the operating temperature-pressure relationship of the wheeled fire extinguisher (see 6.1).

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

8.16.1.4 The maximum indicated gauge pressure shall be between 150 % and 250 % of P_s but not less than 120 % of P_{ms}. The gauge dial shall indicate, in green, the operable pressure range of the extinguisher. The zero, charging, and maximum indicated gauge pressures shall be shown in numerals and with marks. 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. The length of the arc from zero pressure to the indicated P_s shall be at least 12 mm.

8.16.1.5 The mark used to indicate P_s shall be not less than 0,6 mm and not more than 1,0 mm wide.

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

Pressure gauge markings shall be subjected to ultraviolet light testing as specified in 8.10.3. There shall be no significant deterioration of the legibility, such as darkening, fogging, or fading, upon completion of the testing.

8.16.1.7 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:

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.

8.16.2 Pressure gauge calibration test

8.16.2.1 The error of a pressure gauge at the indicated P_s shall not exceed +4 % of P_s. The error at the upper and lower limits of the operable range shall not exceed ±4 % of P_s for powder and water-based extinguisher gauges and +8 % of the charging pressure for clean agent extinguisher gauges. At the zero pressure mark, the error shall not exceed plus 12 %, −0 % of P_s. At the maximum indicated pressure, the error shall not exceed ± 15 % of P_s.

8.16.2.2 The pressure gauge is to be installed on a deadweight gauge tester or a piping apparatus with a master gauge having an accuracy of not less than 0,25 %. The pressurizing medium may be oil, water, nitrogen, or air, but all tests on a given type of gauge are to be conducted using the same medium. The pressure is to be applied to the gauge under test in uniform increments until the upper limit of the gauge is reached. The pressure then is to be reduced in the same increments until the zero point is reached. The pressure applied, the gauge or indicator reading, and net error are to be recorded for each increment in both the increasing and decreasing pressure conditions.

8.16.3 Pressure gauge burst strength test

8.16.3.1 A pressure gauge shall withstand, for 1 min, a pressure of $6 \times P_s$, but not less than 5,5 MPa, without rupture. In addition, if the bourdon tube or pressure-retaining assembly bursts at a pressure less than $8 \times P_s$, no parts of the gauge shall be thrown.

8.16.3.2 A sample gauge is to be attached to a hydraulic pressure pump after all air has been excluded from the test system. The sample is to be placed in a test cage and the pressure applied at a rate of approximately 2,0 MPa/min until the required P_t is reached. The pressure is to be held at this point for 1 min, then increased until rupture occurs or $8 \times P_s$, whichever occurs first.

8.16.4 Pressure gauge overpressure test

8.16.4.1 The difference in readings of indicated P_s before and after a pressure gauge is subjected for 3 h to a pressure of 110 % of the indicated gauge capacity shall not exceed ±4 % of P_s.

8.16.4.2 Sample pressure gauges are to be subjected to the required P_t or 3 h. The pressure shall then be released and the gauges allowed to stand at normal atmospheric pressure for 1 h. The gauges shall then be subjected to the calibration test specified in 8.16.2.

8.16.5 Pressure gauge impulse test

8.16.5.1 The difference in readings of indicated P_s, before and after a pressure gauge is subjected to 1 000 cycles of pressure impulse, shall not exceed ± 4 % of P_s.

8.16.5.2 Sample pressure gauges shall be attached to a regulated source of pressure, either air, nitrogen, or water. The pressure shall then be varied from 0 % to 125 % of the indicated P_s, or from 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 samples shall then be subjected to the calibration test specified in 8.16.2.

8.16.6 Pressure gauge relief test

8.16.6.1 A pressure gauge shall have a pressure relief that will vent in the event of a leak of a pressurized component. This pressure relief shall function at a pressure of 0,345 MPa or less within 18 h. The minimum flow capacity of the pressure relief shall be 1 l/h.

8.16.6.2 This test shall be conducted on pressure gauges with the bourdon tube or other pressurized component cut completely through. The gauge shall be immersed under water with the gauge inlet connected to a regulated source of air or nitrogen. The supply pressure shall be maintained at 0,345 MPa until the pressure relief functions, or for 18 h, whichever is shorter. The flow rate shall be measured with an inverted water column or other equivalent means.

8.16.7 Pressure gauge water resistance test

A pressure gauge shall remain watertight after being immersed in 0,3 m of water for 2 h, and after being subjected to the external corrosion test specified in 6.6.1.

8.16.8 Pressure gauge leakage test

8.16.8.1 A pressure gauge 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 P_s, of the extinguisher at (20 ± 3) °C.

8.16.8.2 A leak detection apparatus and leak standard shall be used to verify compliance with the requirements specified in 8.16.8.1. The leak detection apparatus is to be capable of signalling, and the leak standard capable of generating, a leakage rate of 1×10^{-6} cm^3/s.

8.16.8.3 Twelve sample gauges are to be individually pressurized to a pressure equivalent to P_s, of the extinguisher. Each sample gauge or indicator, other than a pin-type indicator, is then to be subjected to a leak test by checking all pressurized components for leakage in order to verify compliance with the requirements in 8.16.8.1.

8.16.9 Pressure gauge plastics components

Plastic components of pressure gauges shall meet the requirements of 8.10.

8.17 Siphon tubes and filters for water-based extinguishers

8.17.1 The siphon tube of water-based extinguishers shall be of materials resistant to the extinguishing media.

8.17.2 The discharge of the extinguishing agent shall be through a filter which is positioned 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 five times the smallest section of the discharge passage.

8.18 Carriage assembly

8.18.1 Carriage

The carriage assembly of a wheeled fire extinguisher shall be designed to carry all structural loads, i.e., the agent tank and hose retaining unit shall carry no structural load. The carriage shall be designed to protect the tank, hose retaining units and all other components from damage should the unit be toppled from the upright position in any direction.

IMPORTANT — Exception: low-pressure extinguisher medium tanks are permitted to carry structural loads.

8.18.2 Mobility

The carriage assembly of a wheeled fire extinguisher shall be designed so that one man can easily push or pull the extinguisher over level surfaces and grades up to 2 %. If intended to be stored in the upright position, the carriage shall stand in the upright position with the tyres off the ground. The force, applied at the handle, required to tilt the extinguisher from the vertical storage position to the towing position shall not exceed 400 N. The force, applied at the handle, required to lift the extinguisher from the reclined storage position, shall not exceed 400 N. The force required to support the handle when it is (80 ± 5) cm from the ground shall not exceed 150 N.

8.18.3 Hose retaining unit

A receptacle or holding device shall be furnished to securely retain the hose assembly and nozzle. The design shall facilitate rapid deployment at the scene of an emergency with the fewest number of operations. The hose shall be stored in such a manner that it will release easily, without kinking, when it is pulled from the stored position when the extinguisher is in the upright or reclined position.

8.19 Gasket and O-rings

8.19.1 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 when tested in accordance with ISO 37:

a) as received:

- minimum tensile strength – 3,4 MPa for silicone rubber (having polyorgano-siloxane as its characteristic constituent); 6,9 MPa for fluorocarbons; and 8,3 MPa for other elastomers; minimum ultimate elongation –100 % for silicone rubber and 150 % for other elastomers;
- 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 96 h in oxygen at 70 °C and at 2,1 MPa:

- minimum percent of original tensile strength –70 %;
- minimum percent of original elongation –70 %.

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

8.19.2 Compression set

A sample of a rubber or rubber-like part shall have a compression set not greater than 25 % of its original thickness after being compressed by one third of its original thickness.

The compression set test is to be conducted on button samples compressed to two thirds of their original thickness for 24 h at the minimum storage and use temperature; at (20 ± 3) °C and at (60 ± 3) °C.

9 Colour and marking

9.1 Colour

The recommended colour of wheeled fire extinguisher bodies is red.

9.2 Marking

9.2.1 The operating, recharging, and inspection and maintenance instructions for wheeled fire extinguishers shall be in the form of an etched or embossed metal nameplate, band, or a pressure-sensitive nameplate attached to the side of the extinguisher body. The marking shall identify the extinguisher as to the type of media, the manufacturer's name and model number and shall include the Rating and Classification of the fire extinguisher.

9.2.2 Each extinguisher shall have a serial number.

9.2.3 The year of manufacture, or the last two digits of the calendar year, and the factory test pressure shall be permanently marked on the extinguisher body or a non-transferable nameplate. Extinguishers manufactured in the last 3 months of a calendar year may be marked with the following year as the date of