Aerospace series — Handheld fire extinguishers with synthesis gases, for aircraft use — Technical specification and qualification conditions

ICS 13.220.10, 49.095

National foreword

This British Standard is the UK implementation of EN 4649:2009.

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

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 4649:2009) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2009, and conflicting national standards shall be withdrawn at the latest by August 2009.

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Introduction

This standard is implemented to define aeronautical requirements regarding the following:

— all handheld fire extinguishers using synthesis gases;

— all aircraft;

— the need to protect persons, equipment and the environment (in particular the provisions concerning implementation of the Montreal protocol).

If the extinguisher uses a synthesis gas under the terms of a waiver to current legislation, all the tests except the extinguishing efficiency tests, shall be run using an authorised equivalent substitute agent.

This standard is intended for fire extinguishers with a maximum operating pressure up to 25 bars.

1 Scope

This standard specifies the technical requirements and qualification conditions for handheld fire extinguishers made with metal vessels and using synthesis gases for aircraft use, designed for use in the cockpit, in the passenger cabin and to protect areas accessible to the crew.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 9100, *Aerospace series — Quality management systems — Requirements (based on ISO 9001:2000) and Quality systems — Model for quality assurance in design, development, production, installation and servicing (based on ISO 9001:1994)*

EN 9103, *Aerospace series — Quality management systems — Variation management of key characteristics*

EN 9133, *Aerospace series — Quality management systems — Qualification procedure for aerospace standard parts*

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

EN 10204, *Metallic products —Types of inspection documents*

ISO 3941, *Classification of fires*

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

DOT/FAA/AR-01-37, *Development of a minimum performance standard for hand-held fire extinguishers as a replacement for Hamon 1211 on Civilian Transport Category Aircraft* [1]

ED-14D/RTCA/DO-160, *Environmental conditions and test procedures for airborne equipment* [2]

EASA – Part 145, *Maintenance Organisation Approvals* [3]

3 Terms and definitions

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

3.1
pressure-relief safety device
device which releases the pressure inside the vessel in the event of over-pressure

3.2
handheld fire extinguisher
extinguisher designed to be carried and used by hand, weighing 20 kg or less

3.3
bracket
element used to hold the extinguisher on board

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1 Published by: Office of Aviation Research – Washington, D.C. 20591.

2 Published by: EUROCAE, 102 rue Etienne Dolet – 92240 Malakoff.

3 Published by: European Aviation Safety Agency – Postfach 10 12 53 – D-50452 Koeln, Germany.

3.4
survival temperature
temperature to which the extinguisher may be exposed without compromising subsequent use in the operating temperature range

3.5
fire classes
according to ISO 3941, the following fire classes may be identified:

— class A: these are fires of solid materials, generally organic in nature, the combustion of which normally leads to the formation of embers

— class B: these are fires involving liquids or liquefiable solids

According to this standard the following fire class is added:

— class H: these are fires in indirectly accessible spaces (hidden fires)

4 Symbols and abbreviations

bar	Unit of pressure, 1 bar is equal to 0,1 MPa
IF	Inspection File
DF	Definition File
MF	Manufacturing File
P (T max.)	Pressure at maximum operating temperature
P (T min.)	Pressure at minimum operating temperature
TP	Test Pressure
TS	Technical Specification
T max.	Maximum operating temperature
T min.	Minimum operating temperature
V	Internal volume of the vessel

5 Description

A handheld fire extinguisher consists of, but is not limited to:

— a vessel;

— an extinguishing agent;

— a pressurisation agent if necessary (acting as the propellant);

— a pressure indicating device;

— a pick-up device;

— a controlling device;

— a projection device;

— a discharge hose if necessary;

— a pressure-relief safety device;

— a controlling device locking system;

— an indicator of not used.

NOTE The bracket is independent of the extinguisher, but shall be qualified jointly with it.

6 Design

6.1 General

The fire extinguisher shall operate in vertical position with the actuating device on the top.

No part shall easily be removable from the fire extinguisher and its bracket except the controlling device locking system.

The design of handheld fire extinguishers shall enable them to withstand the environmental conditions specific to the aeronautical field, as defined in Clause 8:

— mechanical (vibrations, crash resistance, operational shocks);

— climatic (temperature, altitude, humidity, salt mist);

— electromagnetic, if applicable.

6.2 Materials

The materials used to manufacture the fire extinguisher shall comply with the standards in force, shall be resistant to the extinguishing and pressurising agents and shall withstand the environmental and operating conditions.

For this purpose, the designer shall determine the appropriate materials, heat treatments and protections.

Magnesium alloys are prohibited.

6.3 Vessel

The manufacturer shall obtain and record the analysis and testing certificates for the materials used to manufacture the vessels. The inspection documents shall provide the composition of the material and results of the chemical analysis and the results of the mechanical tests in accordance with EN 10204.

The vessel shall be made of metal and its design shall comply with the requirements of 7.2. If a material other than metal is used, the manufacturer must show evidence that this material is compliant to the requirements set forth in this standard. Dedicated test procedures for this material must be developed by the supplier.

6.4 Extinguishing and pressurising agents

The products used shall comply with the applicable standards and regulations in force.

6.5 Pressure-relief safety device

The fire extinguisher may be equipped with a pressure-relief safety device designed to protect the pressurised elements against over-pressure.

The operation of this device shall be based on the pressure rise principle.

The design of this device shall comply with the requirements of 7.3.1.

This device may also be used as a filling device.

If not fitted with a pressure-relief safety device, the fire extinguisher shall be designed to automatically evacuate its entire contents safely, in case of over pressure. In this case, the provisions of 7.3.2 shall apply.

6.6 Pressure indicating device

The handheld fire extinguisher shall be equipped with a device indicating that the pressure of the fire extinguisher is within operating limits.

6.7 Pick-up device

This device shall allow an efficient pick-up of the extinguishing agent.

6.8 Projection device

This device shall allow efficient and easy projection of the extinguishing agent onto the fire.

6.9 Controlling device

This device shall be used to start and stop the flow of extinguishing agent.

6.10 Discharge hose

The fire extinguishers with more than 2 kg of agent(s) shall be equipped with a hose.

6.11 Controlling-device locking system

This device is designed to prevent inadvertent actuation.

6.12 Indicator of not used

This device shall show whether the fire extinguisher has been operated.

This may be in the form of a wire and seal or a mechanism that prevents re-insertion of the safety device.

6.13 Bracket

This device is used to hold the fire extinguisher on board.

The fire extinguisher shall be easily removable from its bracket and the related operating method shall be obvious and non-ambiguous.

7 Characteristics

7.1 General

All pressure shall be in accordance with Annex A.

The pressure levels reached in the vessel shall be determined according to the agent(s) used, the filling coefficient, the pressurisation pressure, the maximum survival temperature.

The minimum range of operating temperature is – 40 °C to 70 °C.

The minimum range of survival temperature is – 55 °C to 85 °C.

An attachment of elements on the vessel shall not weaken its mechanical strength.

7.2 Vessel

7.2.1 Thickness of the wall

The thickness of the wall shall be such that regardless of the extinguishing agent used and its vapour pressure, the 0,2 % offset yield strength of the material chosen shall never be exceeded at the vessel test pressure.

If markings are etched, these shall be done in a dedicated area.

7.2.2 Mechanical properties

The ratio shall be:

$$\frac{R_{p0.2}}{R_m} \leq 0{,}90$$

where

$R_{p0.2}$ is the yield strength, see EN 10002-1;

R_m is the tensile strength, see EN 10002-1.

7.2.3 Test pressure

The test pressure shall be minimum equal to 125 % of the pressure corresponding to the maximum survival temperature.

7.2.4 Burst pressure

The burst pressure shall be minimum equal to 270 % of the pressure corresponding to the maximum survival temperature.

7.3 Safety in case of over-pressure

7.3.1 Pressure-relief safety device

Pressure levels for activation of the pressure relief safety device shall be:

— minimum: pressure equivalent to 105 % of the pressure at maximum survival temperature,

— maximum: pressure equivalent to the test pressure (7.2.3).

7.3.2 Fire extinguisher without a pressure-relief safety device

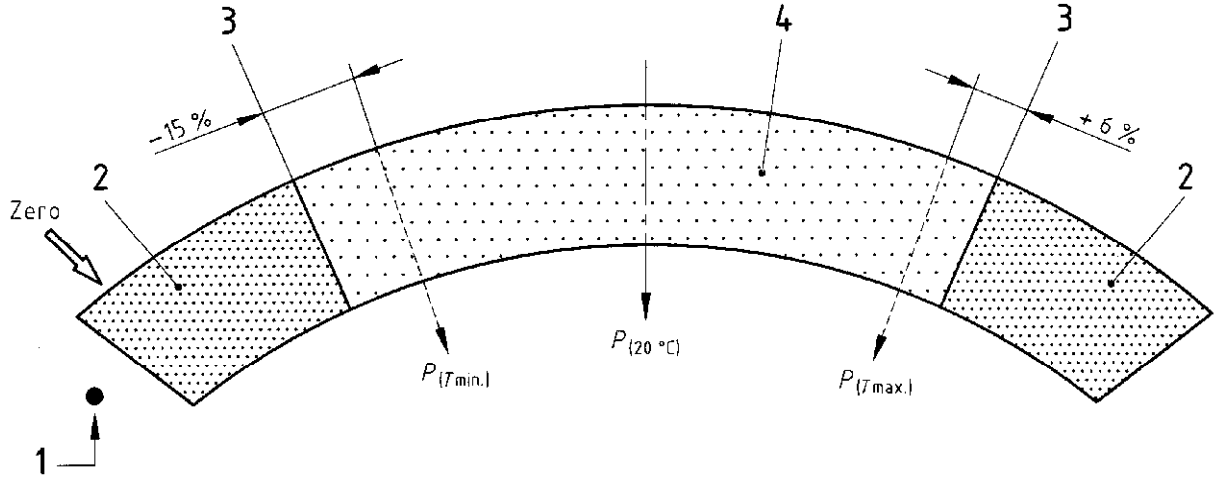
In case of over pressure, no mechanical element shall be ejected from the fire extinguisher and the fire extinguisher shall remain in its bracket.

7.4 Pressure indicating device

The reading range of the pressure indicating device shall comprise (see Figure 1):

— a zero reference (to indicate zero pressure). If there is a needle stop, it shall be below the zero reference.

— a green zone (4) corresponding to the pressures of the whole operating temperature range in accordance with Figure 1.



Key

1 Stop
2 Red
3 Rounded-off to 0,5 bar
4 Green

$P_{(T\,min.)}$ Pressure at minimum operating temperature

$P_{(T\,max.)}$ Pressure at maximum operating temperature

Figure 1

The pressures are rounded off to the nearest half-bar or bar.

The zones located on either side of the green zone are red.

To ensure that the pressure indication is readable, the characteristics shall be as follows:

— the needle movement across the pressure zone shall allow a clear reading;

— a mark shall show the pressure at the temperature of 20 °C.

NOTE An indicating device giving the same indications as mentioned above is also acceptable.

7.5 Pick-up device

The pick-up device (e.g. plunger tube) shall allow drainage of at least 90 % of the extinguishing agent during the test defined in 8.4.1.

7.6 Controlling device

The characteristics of the controlling device are as follows:

— actuation of the controlling device shall, within 2 s, start emission of the extinguishing agent stream and shall stop it as soon as the controlling device is released;

— tightness shall be ensured between two emissions to comply with 8.4.4;

— it shall be actuated with one hand only applying a maximum strength of 10 daN.

7.7 Controlling-device locking system

The characteristics of the controlling-device locking system are as follows:

— it shall be unlocked with a strength between 2 daN to 10 daN;

— it shall withstand a strength of 20 daN applied to the controlling device without damage and shall remain removable after release of the force.

7.8 Indicator of not used

When activated, it shall not be possible to restore the indicator in its initial condition without intervention of qualified operator with appropriate tool.

If the controlling device is operated, the status of indicator of not used shall change.

7.9 Projection device

— It shall allow an efficient projection of extinguishing agent onto the fire.

— It shall create a visible stream to allow the user to orientate it onto the fire.

7.10 Discharge hose

7.10.1 Hose – sizing

— fire extinguishers with more than 2 kg of agent(s) shall be equipped with a hose of minimum length 400 millimetres;

— if the fire extinguishers with 2 kg or less of agent(s) are equipped with a hose, the minimum length of this hose shall be 250 millimetres.

7.10.2 Hose – mechanical strength

The hose attached to the fire extinguisher and all its connections shall withstand a pull strength equivalent to twice the mass of the full fire extinguisher without damage.

7.10.3 Hose – pressure strength

The hose burst pressure shall be at least three times the maximum-operating temperature pressure, with the test run at ambient temperature.

7.11 Discharge duration

The discharge duration shall be in accordance with ISO 7165.

The discharge duration is taken to mean the time for which extinguishing agent is discharged without interruption, with the valve fully opened. The emission of any propellant gas is not considered here.

The discharge duration at T min. and T max. shall not exceed the average discharge duration measured at ambient temperature by more than 50 %.

7.12 Bracket

The bracket shall withstand shocks and vibration of the bracket plus fire extinguisher assembly.

NOTE The bracket may be used to prevent inadvertent actuation of the fire extinguisher control system.

7.13 Fire extinguisher tightness

Leakage shall be limited to:

— 1 cc of gas per day and per kilogram of extinguisher charge or 1 cc of gas per day and per litre of extinguisher charge;

— loss of charge mass not exceeding 5 % per year.

7.14 Visual access

When the fire extinguisher is installed on its bracket, the following points shall be visible:

— code symbols of fire classes;

— pressure indicating device;

— controlling-device locking system has not been unlocked.

8 Qualification tests

8.1 General test conditions and definition

8.1.1 Application of qualification

The qualification procedure requires:

— transmission of the qualification application to the competent authorities in accordance with applicable regulations;

— the technical documentation defining the equipment, including justification of the pressure strength through the calculation note or experimental design method;

— the technical user's guide;

— the technical data sheet in accordance with the specimen in Annex C.

8.1.2 Equipment for qualification

A minimum of 21 fire extinguishers with brackets to be qualified shall be submitted in operating condition. See Annex D.

If not already qualified in accordance with this standard, the following components shall be submitted for qualification purpose:

— vessel: 5 units for each test. See 8.3.

— pressure indicating device: 5 units. See 8.4.3.

— pressure-relief safety device: 10 units where applicable. See 8.4.2.

— discharge hose: 5 units where applicable. See 8.4.6.

8.1.3 General test conditions

Unless otherwise specified, the tests shall be performed in the following ambient conditions:

— temperature: between 15 °C and 25 °C;

— atmospheric pressure: between 86 kPa and 106 kPa;

— relative humidity: less than 85 %.

The equipment shall be in a stabilized condition before beginning of each test.

8.1.4 Test chronology

The summary table of extinguisher's qualification tests is given in Annex D.

All the fire extinguishers that have undergone qualification shall not be used after qualification.

8.1.5 General check

Each test shall be preceded and followed by a visual inspection and a check of the mass of the fire extinguisher.

8.2 Weighing

The following masses shall be mentioned in the technical data sheet, see Annex C:

— empty fire extinguisher;

— full fire extinguisher in operating condition;

— bracket.

NOTE For weighing, the empty or full fire extinguisher is considered without the bracket and without protection elements used for transport and storage.

8.3 Tests on the vessel

8.3.1 Pressure test

An internal pressure will be applied to the vessel.

All the orifices shall be blanked using appropriate plugs. The pressure rise shall be slow and gradual, with a maximum average gradient of 2 bars per second.

A stabilized internal pressure shall be applied for 30 s minimum, equal to the test pressure defined in 7.2.3. The assembly shall remain tight and shall show no defect.

After releasing the pressure and stabilization of 30 s minimum, check that the volume has not increased by more than 1 % over the initial volume and that there is no damage to the material such as fractures or cracks.

8.3.2 Crush test

8.3.2.1 General

Mandrel(s) is(are) positioned as shown in Figures 2 to 5 in order to minimise the risk of damaging the coupling port used to pressurise the vessel. If necessary, any other means for pressurising the vessel may be used.

The length of the vessel is the maximum distance between the ends of the pressure envelope excluding all skirt and couplings.

8.3.2.2 Long vessels

The following method is applied to a vessel with a length of more than 1,5 times the outside diameter.

The vessel shall be installed on a non-shrinking surface and it shall be crushed by a non-shrinking block (mandrel) of radius $R = (D/2 \pm 10)$ mm with a length such that it sticks out of both sides of the crushed vessel.

Vessels without welding

Crushing shall be performed perpendicularly to the longitudinal axis and in the middle of the length of the vessel (see Figure 2).

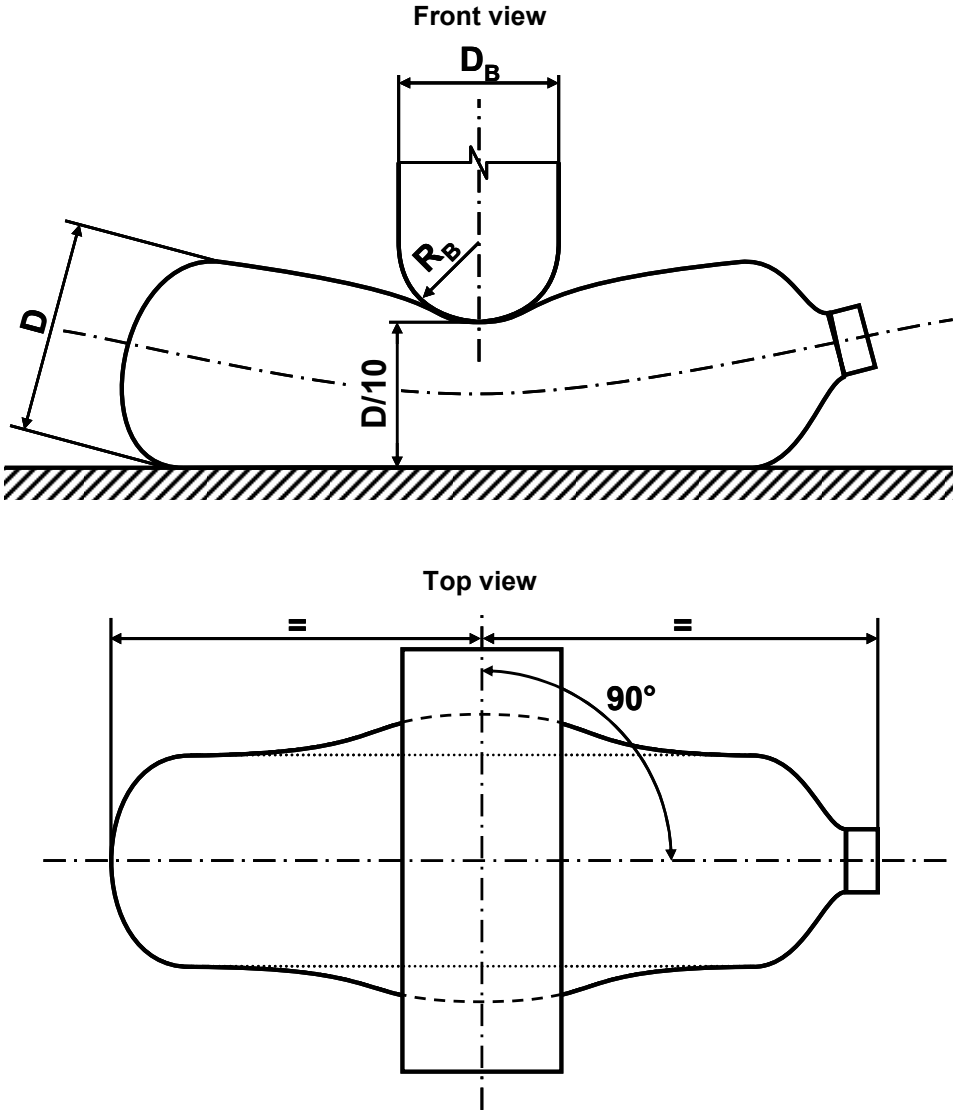


Figure 2

Crushing is performed until the distance between the block and the non-shrinking surface is within (10 ± 1) % of its external diameter D. The duration of the crushing is between 30 s and 60 s.

Vessels with a longitudinal welding(s)

The welding(s) shall be located in accordance with Figure 3.

Crushing shall be performed perpendicularly to the longitudinal axis and in the middle of the length of the vessel.

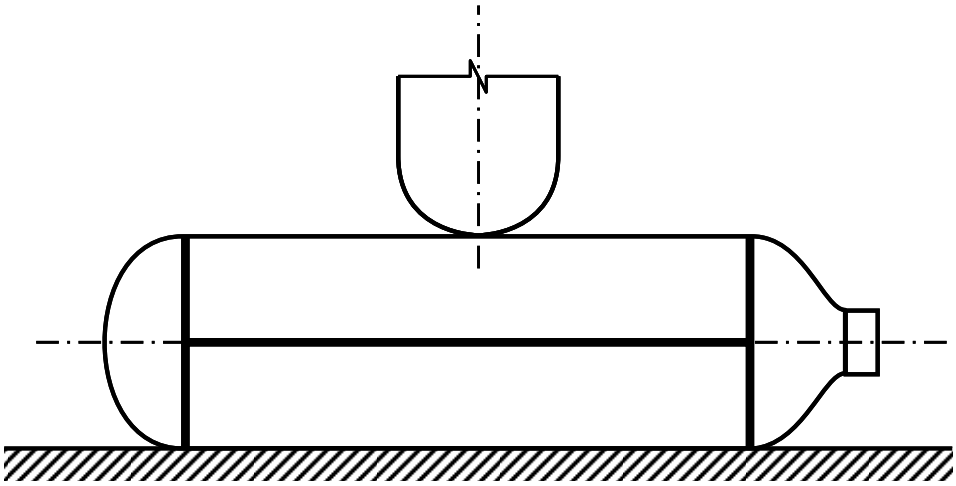


Figure 3

Vessels with a transverse welding

Crushing shall be performed at an angle of 45° with the longitudinal axis and in the middle of the length of the vessel (see Figure 4).

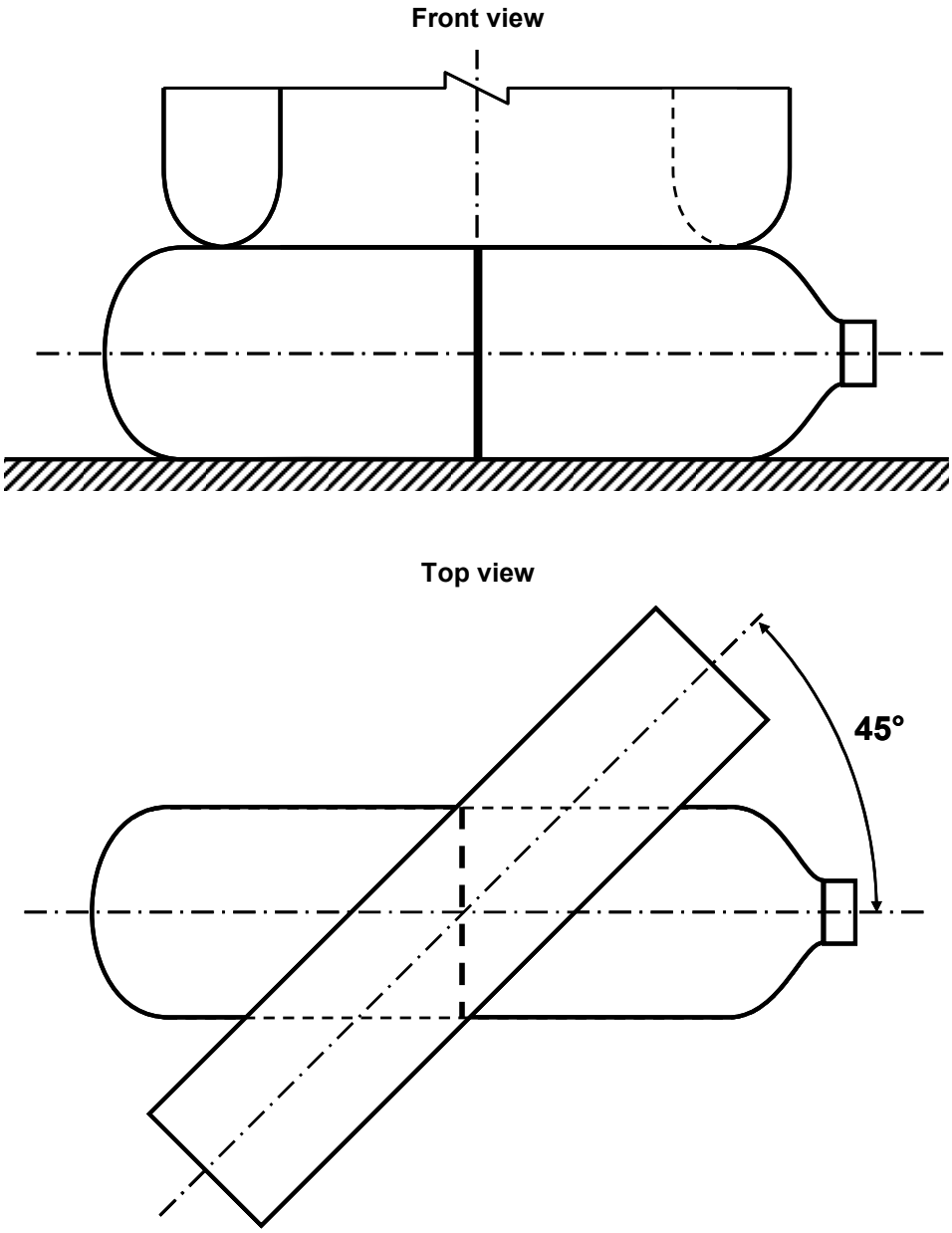


Figure 4

After the crush test, the vessel shall be filled with water and submitted to the pressure defined in 7.2.3. The vessel shall not have crack or leak.

8.3.2.3 Short vessels

The following method is applied to vessel which length is less than or equal to 1,5 times the external diameter.

Short vessels without welding

A vessel is crushed perpendicularly to the approximate centre of its longitudinal axis by two non-shrinking blocks 25 mm wide, with a half-cylinder radius of R = 12,5 mm and a length such that they stick out both sides of the crushed vessel (see Figure 5).

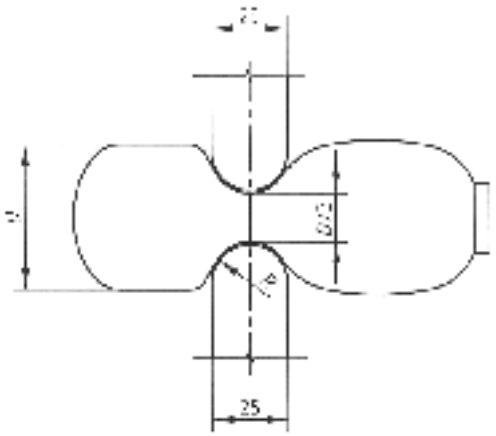


Figure 5

Crushing is performed until the distance between blocks is within $D/3 \pm 1\ \%\ D$ as shown in Figure 5. The duration of the crushing is between 30 s and 60 s.

For vessels with a longitudinal welding, the welding shall be located in accordance with Figure 3.

For vessels with a circumferential welding or with a welding in the contact area, crushing shall take place at an angle α of between 45° and 90° to the longitudinal axis of the vessel in accordance with Figure 4.

After the crush test, the vessel shall be filled with water and submitted to the pressure defined in 7.2.3. The vessel shall not have crack or leak.

8.3.3 Pressurised burst test

The vessels intended for the pressurised burst test are mounted in a hydraulic device used to apply an internal rising pressure with a maximum average gradient of 2 bar/second. The burst pressure measured shall be at least 2,7 times the pressure at maximum survival temperature.

All the orifices shall be blanked with appropriate plugs.

The bursting test shall not cause the vessel to fragment.

During the burst test, no parts shall be ejected.

The tear will not originate in either a welding or in the marking.

8.3.4 Low temperature toughness test

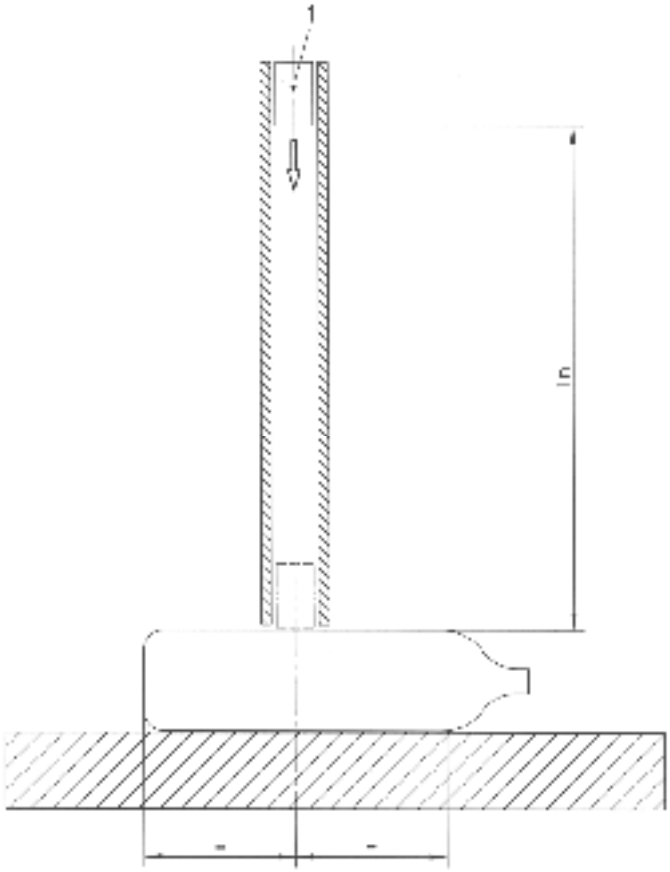
To check the impact strength of the material.

Description of the test:

— prepare the empty vessel at the stabilized minimum survival temperature for at least 2 h;

— within the minute, install the vessel as shown on Figure 6, on a non-shrinking surface; and drop a 4 kg flat-ended cylindrical mass 75 mm in diameter placed in a guide and free-falling vertically from a height of 1 m;

— let the vessel to return and stabilize at ambient temperature and then conduct the pressure test in accordance with 8.3.1.



Key

1 Flat-ended cylindrical mass

Figure 6

8.4 Operating tests

8.4.1 Fire extinguisher

8.4.1.1 General

All fire extinguishers shall operate within 2 s after the actuation of actuating device.

8.4.1.2 Discharge test at ambient temperature

The following test is to be performed on 3 fire extinguishers in operating condition.

— Store at ambient temperature for 12 h.

— Check that the reading given by the pressure indicating device is within the green zone.

— Weigh the fire extinguishers in accordance with 8.2.

— Continuously discharge the fire extinguisher while measuring the discharge duration in accordance with 7.8.

— Weigh again the fire extinguisher and check that the quantity of extinguishing agent discharged is in accordance with 7.5.

NOTE None of the 3 discharge duration measurements shall deviate from the average value by more than 15 %.

8.4.1.3 Integrity test at maximum survival temperature followed by discharge at T max.

The following test is to be performed on 1 fire extinguisher in operating condition.

Weigh and record the mass of the extinguisher.

Install it in a climatic chamber.

Increase the temperature with a gradient of about 5 °C per minute up to the maximum survival temperature.

Store at this temperature for 12 h.

Gradually decrease the temperature to T max. and maintain this temperature for 12 h.

Within two minutes following removal from the climatic chamber:

— check that the reading given by the pressure indicating device is within the green zone;

— weigh the fire extinguishers in accordance with 8.2;

— continuously discharge the fire extinguisher while measuring the discharge duration in accordance with 7.8;

— weigh again the fire extinguisher and check that the quantity of extinguishing agent discharged is in accordance with 7.5.

8.4.1.4 Integrity test at minimum survival temperature followed by discharge at T min.

The following test is to be performed on 1 fire extinguisher in operating condition.

Weigh and record the mass of the extinguisher.

Install it in a climatic chamber.

Decrease the temperature with a gradient of about 5 °C per minute down to the minimum survival temperature.

Store at this temperature for 12 h.

Gradually increase the temperature to T min. and maintain this temperature for 12 h.

Within two minutes following removal from the climatic chamber:

— check that the reading given by the pressure indicating device is within the green zone;

— weigh the fire extinguishers in accordance with 8.2;

— continuously discharge the fire extinguisher while measuring the discharge duration in accordance with 7.8;

— weigh again the fire extinguisher and check that the quantity of extinguishing agent discharged is in accordance with 7.5.

8.4.2 Over-pressure safety test

8.4.2.1 Over-pressure test for fire extinguisher fitted with safety device

8.4.2.1.1 Over-pressure test of the safety device

The safety device is mounted on a test tool representative of the mounting on the extinguisher.

— Test at ambient temperature on 5 safety devices: raise the pressure with a maximum gradient of 5 bar/minute. The safety device shall release at the pressure defined in 7.3.1 and record the results.

— Test at maximum survival temperature on 5 safety devices: increase the temperature to the maximum survival temperature ± 2 °C stabilized for 1 hour and apply the pressure corresponding to this temperature for 1 minute without release. Then, raise the pressure with a maximum gradient of 5 bar/minute. The safety device shall release at the pressure defined in 7.3.1, and record the results.

8.4.2.1.2 Controlling device integrity test

Submit the fire extinguisher to hydraulic pressure equal to the vessel test pressure for 30 s. The rise shall be slow and gradual at a maximum gradient of 2 bar/second.

Verify the integrity of the controlling device on the vessel.

8.4.2.2 Over-pressure test for fire extinguisher designed without safety device

Submit the fire extinguisher in operating condition and fitted with its bracket to the maximum survival temperature ± 2 °C stabilized for 1 hour in order to check fire extinguisher integrity.

Requirements

Then submit the fire extinguisher fitted with its bracket to a temperature gradient of 5 °C per minute until release of the extinguishing agent, without ejection of mechanical element and without ejection of fire extinguisher from its bracket.

8.4.3 Pressure indicating device

Test to be performed on each sample:

— Pneumatically pressurise the indicating device until it shows the reference P (20 °C). In this position read the pressure on a measuring instrument. This pressure shall not deviate by more than 15 % from the nominal value of P (20 °C) for the related fire extinguisher.

— Pneumatically pressurise the indicating device until it shows the lower limit of the green zone. In this position read the pressure on a measuring instrument. This pressure shall not deviate by more than 20 % from the nominal value of [P (T min.) – 15 %] for the related fire extinguisher.

— Pneumatically pressurise the indicating device until it shows the upper limit of the green zone. In this position read the pressure on a measuring instrument. This pressure shall not deviate by more than 20 % from the nominal value of [P (T max.) + 6 %] for the related fire extinguisher.

8.4.4 Tightness of the controlling device

— actuate the controlling device to discharge the extinguishing agent during 1 s to 1,5 s;

— measure the internal pressure immediately after releasing the controlling device;

— measure the internal pressure again after 6 h.

Requirements: the value of the second pressure shall be at least 80 % of the first measurement.

NOTE The other requirements of 7.6 are also checked.

8.4.5 Controlling device locking system

When installed, check that the controlling device locking system:

— can be unlocked in accordance with 7.7;

— is not damaged after a controlling device actuation in accordance with 7.7;

— do not permit any discharge when the controlling device is operated;

— remains removable after releasing the controlling device in accordance with 7.7.

8.4.6 Discharge hose

Check that the discharge hose is compliant with 7.10.

8.5 Environment tests

8.5.1 Mechanical tests

8.5.1.1 Recommendations

The mechanical tests shall be performed with the fire extinguisher installed in its bracket and oriented in accordance with the manufacturer recommendations.

8.5.1.2 Vibrations

The fire extinguisher installed in its bracket shall undergo vibration tests in accordance with RTCA/DO-160 Section Vibration category U.

8.5.1.3 Shocks and accelerations

The fire extinguisher installed in its bracket shall undergo shock and acceleration tests in accordance with RTCA/DO-160 Section Operational Shocks and Crash Safety category B test R.

8.5.1.4 Requirements

After the previous 2 tests, let the fire extinguisher to stabilize during 48 hours:

— check the integrity of fire extinguisher and its bracket;

— check that the reading given by the pressure indicating device is within the green zone;

— weigh the extinguisher in accordance with 8.2;

— operate the fire extinguisher in accordance with 8.4.1.3;

— the discharge period shall conform to 8.4.1.3 and shall not deviate more than 50 % from the average discharge period measured at 8.4.1.2;

— the quantity of extinguishing agent discharged shall conform to 7.5.

8.5.2 Climatic tests

8.5.2.1 Tests at minimum and maximum operating temperatures

— humid heat, see RTCA/DO-160 Section Humidity category B;

— salt mist, see RTCA/DO-160 Section Salt spray category S.

8.5.2.2 Requirements

At the end of the previous tests, leave the extinguisher to stabilize for 24 hours:

— there shall be no visible traces of corrosion likely to compromise the operation or safety of the extinguisher;

— check that the reading given by the pressure indicating device is legible in the green zone;

— weigh the extinguisher in accordance with 8.2;

— then operate the fire extinguisher in accordance with 8.4.1.3;

— the discharge period shall conform to 8.4.1.3 and shall not deviate more than 50 % from the average discharge period measured at 8.4.1.2;

— the quantity of extinguishing agent discharged shall conform to 7.5.

8.5.3 Electromagnetic tests

This requirement does not apply to equipment of purely mechanical construction.

In the case of a construction incorporating an electromechanical device, the requirements of the relevant section of RTCA/DO160 shall apply.

8.5.4 Operating test in case of energised electrical device

The suitability for extinguishing in the presence of energized electrical device shall be assessed in accordance with the following dielectric test:

Purpose of the test

This test is used to determine whether the extinguisher can be used on energised electrical installations, by measuring the conductivity of the jet.

The test shall be performed in accordance with Annex B.

Current measurement

With the extinguisher in operation and the metal plate energized, the current intensity between the discharge device handle and ground, and between it and the extinguisher, shall be 0,5 mA or less for the time taken to completely discharge the extinguisher.

8.6 Extinguishing efficiency tests

8.6.1 Efficiency requirements

— a minimum 34B in accordance with ISO 7165;

— a minimum 1A and 70B in accordance with ISO 7165 for accessible cargo compartments.

8.6.2 Efficiency on class A fire

When the extinguishing agent is appropriate to this type of fire, the extinguisher efficiency in this class shall be assessed in accordance with standard ISO 7165. The minimum efficiency specified in this standard shall be achieved.

8.6.3 Efficiency on class B fire

The extinguisher shall be assessed in accordance with ISO 7165.

8.6.4 Efficiency on class H hidden fire

The extinguisher shall be assessed in accordance with the Minimum Performance Standard (MPS) reference DOT/FAA/AR-01/37.

8.6.5 Application on seat fire

The extinguishing agent shall be assessed in accordance with MPS reference DOT/FAA/AR-01/37.

9 Manufacturing requirements

9.1 General

The MF and DF shall take account of the standards and legislation in force and the requirements of this article. The notion of sampling and batch applies:

— fire extinguisher;

— vessel;

— pressure-relief safety device.

Per type, the requirements concern:

— the definitions of sampling and homogeneous batch;

— the specific batch or unit tests and checks;

— traceability.

Batch sampling will be carried out for performance of specific tests.

A homogeneous batch consists of subassemblies and primary elements from the same manufacturing run, in which the materials and sensitive elements themselves come from homogeneous material batches.

For the material used in the vessels and safety devices, a material certificate of conformity shall be supplied, stating:

— the chemical composition;

— the as-delivered mechanical properties.

All records shall be available for at least the intended life duration of the extinguisher.

9.2 Specific tests

The specific tests concerning the extinguisher and those concerning the main subassemblies, defined by the manufacturer in the MF and the DF, shall:

— conform to the particular requirements of the TS when applicable;

— guarantee that the performance of the production items is maintained.

It is up to the manufacturer to set up a range of written procedures to confirm performance of these tests.

9.3 Specific monitoring of vessel manufacture

9.3.1 Monitoring of manufacturing process

The vessels shall be manufactured in homogeneous batches.

Material monitoring

For performance of the batch tests, the following are required:

— the material mechanical properties:
  — the ultimate tensile strength (R_m);
  — the offset yield strength ($R_{p0,2}$);
  — the elongation (A %);
  — the impact strength (K).

  These properties shall be confirmed by a test on a test specimen if the test results are not included in the material inspection document.

— the material chemical properties shall conform to the MF material standard.

Assembly monitoring

All welding operations shall be performed by a qualified welder in accordance with the standards in force.

The welding procedures shall be based on a welding procedure specification and shall be certified in accordance with the standards in force.

9.3.2 Heat treatment monitoring

If at least one heat treatment is planned in the production cycle, this treatment shall be performed on homogeneous batches. A given batch may be split into several secondary heat treatment batches, but for each one a copy of the heat treatment record shall be provided in order to ensure that it is identical for each secondary batch.

In the case of heat treatment non-conformity with the specifications of the quality document, heat treatment may be repeated once.

9.3.3 Batch Monitoring

Take samples as defined in Table 1.

Submit these vessels to the burst test with a hydraulic pressure according to 8.3.3 and the crush test according to 8.3.2.

Any non-conformity with the requirements of the crush test or burst test shall lead to taking of a further sample four times larger than the first one. In the event of another non-conformity, the batch shall be rejected.

Table 1 — Number of vessels to be sampled

Number of vessels per batch	Total	Crush test (as defined in 8.3.2)	Burst test (as defined in 8.3.3)
$N \leq 500$	3	1	2
$500 < N \leq 1\,500$	5	2	3
$1\,500 < N \leq 3\,000$	7	3	4
$N > 3\,000$ and per additional block of 1 000	+ 2	+ 1	+ 1

9.3.4 Unit monitoring

Test pressure

The resistance of each vessel to the test pressure shall be checked using a hydraulic test. Apply the test pressure for 30 seconds and after release of the pressure check that there is no visible deformation or cracking.

The date of the first test shall be marked on each vessel as stated in Clause 10. The test date constitutes the starting point for the time between overhauls and, if applicable, the shelf-life of the extinguisher.

9.4 Monitoring of vessel auxiliary parts

9.4.1 Pressure-relief safety device

The pressure-relief safety device shall be checked per batch. In each batch, the pressure relief device samples shall conform to Table 2 and shall be tested in accordance with the following procedure.

This device is mounted on a test tool representing the attachment to the extinguisher. Increase the temperature to the maximum survival temperature ± 2 °C and stabilize for 1 hour.

Then raise the pressure at a maximum average gradient of 5 bar/minute, the safety device shall trip at the pressures defined in section 7.3.1.

The batch shall be rejected in the event of non-conformity.

Table 2

Number of pressure relief devices	Number of samples
$N \leq 500$	2 % with a minimum of 3 items
$N > 500$	1 %

9.4.2 Pressure indicating device

Apply the general reception and inspection rules of EN 9100.

9.4.3 Pick-up device

Apply the general reception and inspection rules of EN 9100.

9.4.4 Projection device

9.4.4.1 Without hose

Apply the general reception and inspection rules of EN 9100.

9.4.4.2 With hose

Check that the hose, installed on the extinguisher or a representative set-up, can withstand a pull force corresponding to twice the mass of the full extinguisher without damage. The number of samples shall conform to Table 2 and any non-conformity with the requirements of the tests shall lead to a further sample being taken, twice the size of the first one. In the event of a further non-conformity, a single batch rework is authorized.

9.4.5 Controlling device

Apply the general reception and inspection rules of EN 9100.

9.4.6 Controlling device locking system

Apply the general reception and inspection rules of EN 9100.

9.4.7 Bracket

Apply the general reception and inspection rules of EN 9100.

9.5 Filling and pressurising the fire extinguisher

The mass of extinguishing agent shall be equal to the nominal charge within ± 2,5 %.

The stabilized pressure of the fire extinguisher shall be within ± 2,5 % of the expected nominal pressure at current temperature.

Record for each unit:

— actual mass of extinguishing agent;

— actual pressure,

— actual temperature.

These values shall comply with the MF.

9.6 Fire extinguisher assembly monitoring

The manufacturer shall demonstrate that each fire extinguisher produced by the assembly process is in accordance with the DF and MF.

10 Marking

10.1 Requirements

The MF shall define the content and type of marking in accordance with the following requirements for:

— **the vessel**
The vessel marking is an integral part of the vessel and shall in no way be altered by the various hazards to which it is exposed during the course of its life cycle. A vessel that has lost its identification or received other markings not defined in 10.2 shall be withdrawn from service.

— **the fire extinguisher**
Marking of the fire extinguisher shall be indelible and withstand the various hazards to which it is exposed during its period of use. A fire extinguisher that loses its identification shall be suspended from use and only returned to service once it is again conforming.

— **the bracket**
The markings on the installed bracket shall be apparent, indelible and shall withstand the various hazards to which it is exposed during its period of use. A bracket that loses its identification shall be suspended from use and only returned to service once it is again conforming.

The markings shall not compromise structural integrity and mechanical strength of the vessel or the operation of the fire extinguisher.

10.2 Vessel markings

The markings shall comprise:

— the serial number preceded by “S/N”;

— the test pressure preceded by “TP” and followed by the unit of pressure;

— the date of each pressure test: month/year (mm/yyyy).

This marking on the vessel shall be permanent but shall not weaken it. It may be etched if a special area is dedicated for this.

10.3 Fire extinguisher markings

The fire extinguisher markings shall comprise:

— the designation: Fire extinguisher;

— the part number preceded by: “P/N”;

— the serial number preceded by: “S/N”;

— the manufacturer's name or trade mark;

— the nature and nominal mass of the extinguishing agent in kg (for example: Halon1211 - 1.2 kg);

— the pressurisation pressure at 20 °C in bar, preceded by the words: “Pressure at 20 °C”;

— the minimum and maximum operating temperatures in °C, preceded by the words: Operating temperature limits;

— the date of manufacture of the fire extinguisher: month/year (mm/yyyy) preceded by the words: “Date of Manufacture”;

— the real mass in kg of the extinguisher when full (to three decimal places), preceded by the words: Mass of full extinguisher;

— the words: Conforms to EN XXXX (reference of this standard);

— operating instructions in accordance with the "operating instructions" and “use code symbols” chapters of ISO 7165 including the hidden fire pictogram, see Figure 7.

These markings shall not weaken the extinguisher.

Figure 7

10.4 Colour of the vessel

The colour of the vessel shall be red.

11 Maintenance

11.1 General

The maintenance shall be performed in compliance with EASA/Part 145 regulation and with the technical requirements specified in the « Component Maintenance Manual » (CMM) or the « Abbreviated Component Maintenance Manual » (ACMM).

11.2 Weighing

The possible loss of weight of the charged fire extinguisher shall not exceed 5 % of the nominal charge of extinguishing agent.

11.3 Marking of periodic weighing

The markings indicating periodic weighing of the extinguisher shall comprise the following information:

— the actual mass of the charged extinguisher (in kg to three decimal places);

— the date of the inspection month/year (mm/yyyy);

— identifier of the inspector and the inspector's company.

The type of marking shall not weaken the fire extinguisher.

11.4 Marking of subsequent fire extinguisher overhauls

If the fire extinguisher undergoes overhaul, the additional marking for each overhaul shall comprise:

— the identifier of the company concerned;

— the actual mass of the charged extinguisher (in kg to three decimal places);

— the overhaul date: month/year (mm/yyyy) with repairer's inspection stamp;

} These markings shall not weaken the extinguisher.

— the pressure test date of the vessel: month/year (mm/yyyy) with the seal of the regulatory agency, if applicable.

  This marking on the vessel shall be permanent and not weaken it. It may be etched if a special area is dedicated for this.

12 Quality assurance

The quality assurance of the company and the product shall meet the requirements of the EN 9100, EN 9103 and EN 9133.

Specific requirements are defined by the TS.

13 Qualification

13.1 General provisions

At least, qualification is validated once the presented fire extinguishers meet the requirements and the test programme as stipulated in this standard and the TS.

13.2 Tests

The fire extinguishers presented shall be manufactured using the normal production manufacturing resources and methods and shall conform to the MF. The fire extinguisher qualified in this way creates a family of products or becomes a member of a family in accordance with 13.3.

In the event of any special requirements, the number of fire extinguishers needed for qualification, and the number and order of performance of the tests shall be specified.

13.3 Management of family changes

Any change shall be the subject of a study file and other additional checks complementing the qualification file.

The new qualification shall be validated either owing to similarity, or through calculation, or through additional appropriate tests.

For variants or versions that differ from the qualified model, only tests concerning these differences need to be carried out. The consequences regarding the use and safety shall be assessed.

14 Traceability

The manufacturer shall set up a system of records to ensure that a homogeneous manufacturing batch of vessels, safety devices and fire extinguisher filling can be identified.

For qualification and production manufactured items, traceability shall comprise all the documents and elements for archiving (test pieces, records, X-rays, etc.) allowing subsequent identification of all the manufacturing parameters.

The organization of traceability and the archival of documents are the responsibility of the manufacturer's Quality Department, which is required to keep them at the disposal of the Authorities and the customers for a period of at least 10 years and at least 1 year after the first service life period.

15 Packaging

The packaging shall meet the standards and regulations according to the required safety class.

16 Storage

The storage premises shall be ventilated and protected from external environment and weather conditions within the operating temperature limits.

17 Recovery and recycling

Regulations and/or international protocols require the recovery of products declared to be environmentally hazardous. Their recycling or destruction shall comply with requirements concerning:

a) prohibited atmospheric releases other than necessary uses;

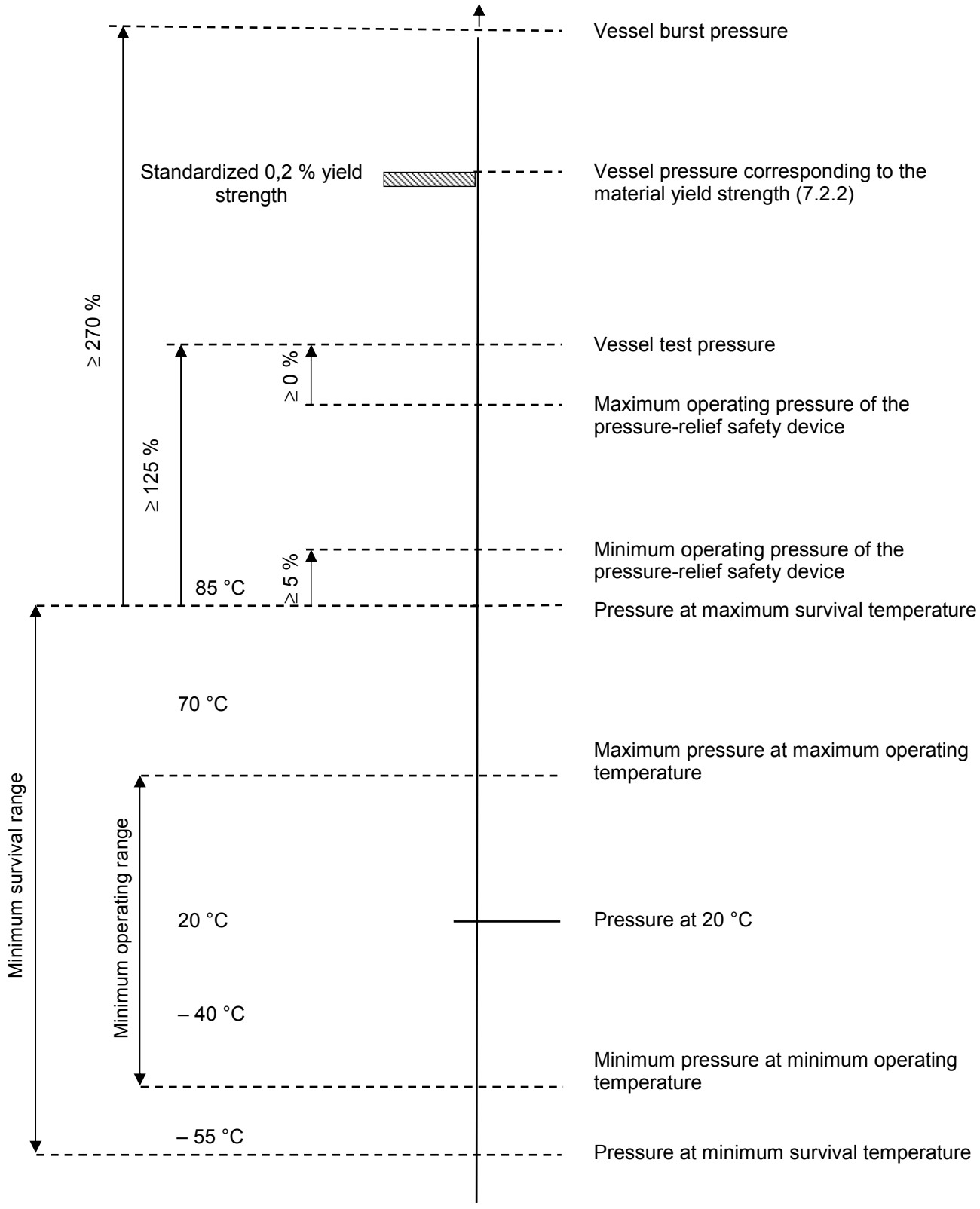
b) mandatory product recovery according to the regulation in force;

c) authorized filling of fire extinguishers with recycled products. The purity of the products shall comply with the standards;

d) products unsuitable for possible re-use shall not be discarded, but destroyed in accordance with the regulation in force.

Annex A
(normative)

Pressure and temperature diagram



Annex B
(normative)

Dielectric test diagram

B.1 Test equipment

A 1 m × 1 m metal plate suspended vertically from isolators, with no object or structure closer than the following:

— 1 m below the plate;

— 1 m on each side of the plate;

— 0,5 m above the plate.

A high-voltage transformer able to create an AC voltage of 35 kV between the metal plate and ground.

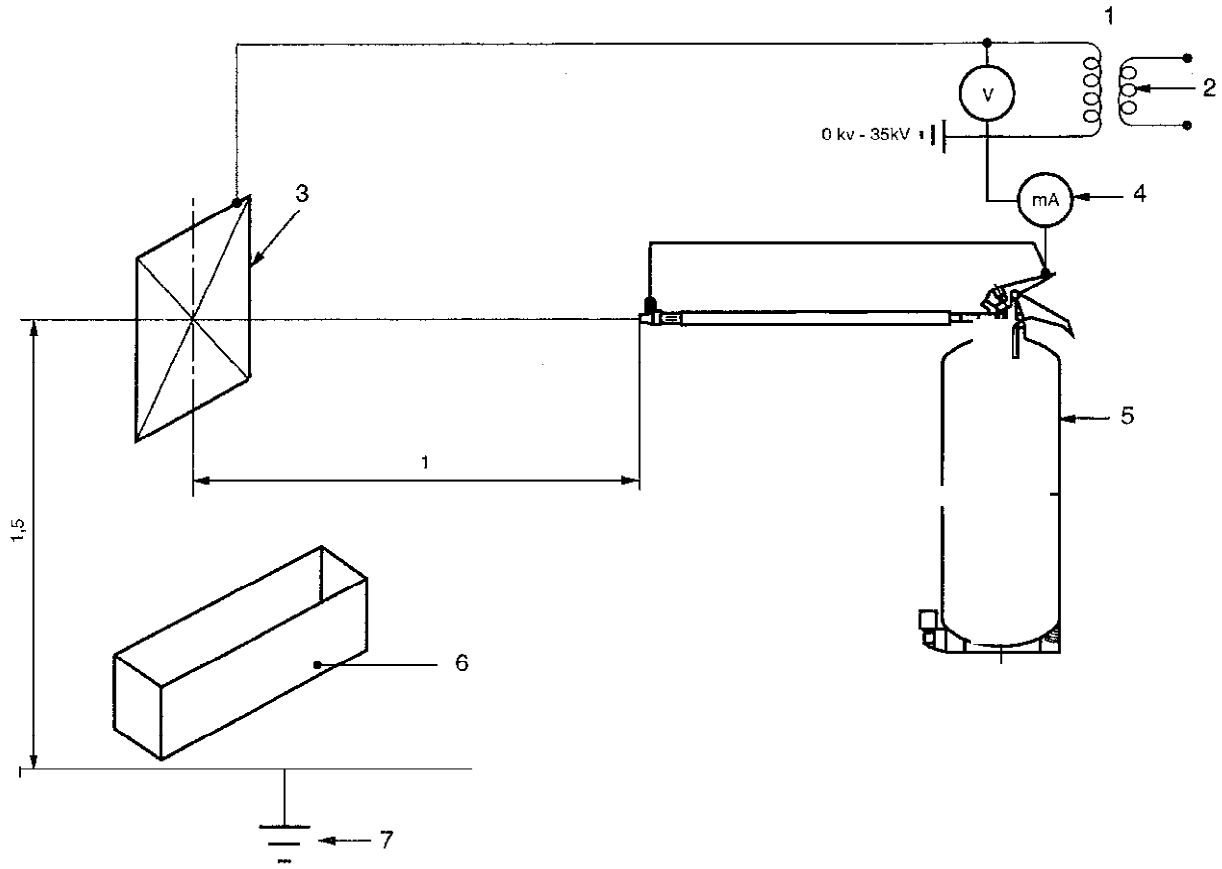
The circuit impedance shall be such that with the secondary short-circuited and the primary supplied with a voltage equal to 10 % of its normal supply voltage, the secondary current is at least 0,1 mA.

An isolating support for fire extinguisher.

B.2 Test procedure

The fire extinguisher is fixed to the isolating support and positioned so that the discharge orifice positioned 1 m from the metal plate is pointing towards its centre.

The current shall be measured with an appropriate instrument connected between the metal plate ground and the various points defined on the extinguisher. If there is no metal link between the extinguishing agent and at least one of the points defined on the measuring instrument, this link shall be created for the purposes of the test.



Key

1 Test transformer
2 Low-voltage power supply
3 Metal plate
4 Ammeter
5 Extinguisher under test
6 Tray (isolated from ground)
7 Ground

Figure B.1 — Dielectric test diagram

Annex C
(normative)

Technical index

The characteristics of the fire extinguishers are defined as follows:

— identification of the material;

— identification of extinguishing agent;

— vessel internal capacity in dm;

— mass of extinguishing agent in kg;

— filling rate;

— identification of pressurising agent;

— nominal mass of pressurising agent;

— empty extinguisher mass;

— full fire extinguisher mass;

— bracket mass;

— operating temperature limits;

— survival temperature limits;

— pressure at 20 °C;

— operating pressure limits;

— operating pressure and temperature limits of the pressure-relief safety device;

— vessel test pressure;

— vessel burst pressure.

Annex D
(normative)

Qualification tests

Test	Designation	Extinguisher index																								Remark	§
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
		Test sequence																									
A	General inspection	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Identification	8.1.5
B	Full extinguisher weighing	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	Manufacturer data	8.2
C	Fire extinguisher operating tests	3	3	3	3	3																					At ambient and limits temperature	8.4.1
D	Controlling device integrity test or Over pressure test	4	4	4	4	4																						8.4.2.1.2 or 8.4.2.2
E	Tightness of controlling device						3																					8.4.4
F	Mechanical tests							3																			According to the required level	8.5.1
G	Climatic tests								3	3																	According to the required level	8.5.2
H	Electromagnetic tests																									3	If applicable	8.5.3
J	Operating test in case of energised electrical device										3																	8.5.4
K	Efficiency test on class A fire											3	3	3														8.6.2
L	Efficiency test on class B fire														3	3	3											8.6.3
M	Efficiency test on class H fire																	3	3	3	3	3						8.6.4
N	Seat fire test																						3	3	3		If necessary	8.6.5

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