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ISO 7076-6

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Fire protection — Foam fire extinguishing systems —

Part 6: Vehicle mounted compressed air foam systems

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

Partie 6: Équipement pour mousse physique à air comprimé monté sur vehicules

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 6, *Foam and powder media and firefighting systems using foam and powder*.

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

— *Part 1: Foam proportioning equipment*

— *Part 2: Low expansion foam equipment*

— *Part 3: Medium expansion foam equipment*

— *Part 4: High expansion foam equipment*

— *Part 5: Fixed compressed air foam equipment*

— *Part 6: Vehicle mounted compressed air foam systems*

Introduction

Compressed air foam systems (CAFS) complying with this part of ISO 7076 are installed in or used in conjunction with fire-fighting vehicles to improve the efficiency of fire-extinguishing processes. Compressed air foam systems improve the adhesion, penetration and retention time of the fire-extinguishing agent on the burning material, thereby transferring more energy, and improving the cooling effect of the applied foam. This is achieved by adding foam concentrates and compressed air, to be delivered into water under pressure by the fire-fighting pump, to the fire.

Compressed air foam systems generate homogeneous foam that increases the effective contact area of the foam on the burning material, and improves the adhesion and penetration of the foam to non-horizontal surfaces of the burning material, thereby increasing the period in which heat is effectively transferred.

It is assumed that systems defined in this part of ISO 7076 will only be operated by properly trained personnel.

For CAFS to be used at a temperature outside this temperature range, the particular temperature range should be specified by the user and the manufacturer should determine by a risk assessment any need for additional precautions.

Fire protection — Foam fire extinguishing systems —

Part 6: Vehicle mounted compressed air foam systems

1 Scope

This part of ISO 7076 specifies requirements for compressed air foam systems (CAFS) in which foam concentrate and compressed air are continuously added to the water being discharged from the fire-fighting pump. This part of ISO 7076 is applicable to CAFS that can be permanently installed in fire-fighting vehicles, transportable, or mobile.

This part of ISO 7076 specifies requirements for CAFS which are used at ambient temperatures ranging from –10 °C to +40 °C.

This part of ISO 7076 does not apply to stationary CAFS.

This part of ISO 7076 does not apply to requirements for hazards related to handling foam concentrates, noise generated by CAFS, drives, auxiliary equipment, power sources, or pumps connected to the CAFS.

This part of ISO 7076 does not specify requirements for special hazards arising from particular conditions under which CAFS are used, for example:

— immunity against electromagnetic fields and electrostatic discharge;

— operation without supervision;

— events specific to the location where the CAFS is set up (e.g. on public roads);

— handling of any equipment, devices, etc., which have to be connected to the CAFS or are joined to it (e.g. branch pipes, nozzles and pressure hoses);

— decommissioning and disposal.

2 Normative references

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

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

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

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

ISO 7000, *Graphical symbols for use on equipment — Registered symbols*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13854, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14120, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 15383, *Protective gloves for firefighters — Laboratory test methods and performance requirements*

IEC 60068-1, *Environmental testing — Part 1: General and guidance*

IEC 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 61310-2, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8421-4, ISO 13943 and the following apply.

3.1
air delivery rate
volume of air, in ambient conditions, that is fed into the CAFS per unit of time

Note 1 to entry: The measurement units are L/min.

3.2
compressed air foam
mixture of water, foam concentrate and compressed air

3.3
compressed air foam delivery pressure
pressure of compressed air foam at the delivery outlet of the CAFS

Note 1 to entry: The measurement units are MPa.

3.4
compressed air foam delivery rate
volume of compressed air foam at the delivery outlet of the CAFS, converted at atmospheric pressure, per unit of time

Note 1 to entry: The measurement units are L/min.

3.5
compressed air foam system
CAFS
system in which a foam concentrate and air are continuously added under pressure to the water being discharged from a fire-fighting pump

3.6
dry foam
operation defined by a nominal foam solution/air volume ratio greater than 1:10, being mixed in the CAFS

3.7
flushing procedure
process to ensure that foam proportioning system associated pipework, to the discharge connection, is adequately cleaned of foam concentrate and solution to avoid any damage

EXAMPLE Procedure to avoid damage by corrosion.

3.8
foam concentrate delivery rate
volume of foam concentrate fed into CAFS per unit of time

Note 1 to entry: The measurement units are L/min.

3.9
foam solution/air volume ratio
relationship between parts of liquid (foam solution) and air (at atmospheric pressure) being mixed together in a CAFS mixing device

Note 1 to entry: The measurement units are L/min.

3.10
foam solution delivery rate
volume of foam solution delivered per unit of time by a system

Note 1 to entry: The measurement units are L/min.

Note 2 to entry: At proportioning ratios of up to 1 %, the difference between water delivery rate and foam solution delivery rate can be neglected.

3.11
operating range
range (of conditions) specified by the manufacturer of a system and within which the CAFS can be operated without limitations while achieving the intended performance characteristics

3.12
proportioning ratio
amount of foam concentrate added to water given as a percentage in the foam solution

3.13
water delivery rate
volume of water fed into CAFS per unit of time

Note 1 to entry: The measurement units are L/min.

3.14
wet foam
operation defined by a nominal foam solution/air volume ratio between 1:3 and 1:10, being mixed in the CAFS

4 Requirements

4.1 Compliance

4.1.1 Type assessments

In order to comply with this part of ISO 7076, the CAFS representative of normal manufacture shall meet the requirements of Clauses 4, 6 and 7, which shall be verified by visual inspection or engineering assessment, shall be tested as described in Clause 5 and shall meet the requirements of the tests (see Annex A for guidance on conducting the assessments).

It is recognized that minor variations occur in the design of CAFS (e.g. to ensure compatibility with multiple truck types). Where minor variations occur and in the interests of economy, only one variant of each model need undergo type assessments. The CAFS should undergo new type assessments where a design change is likely to affect a requirement of this part of ISO 7076. The extent of the re-assessment can be limited, depending on the type of design change that has been made to the CAFS. In all cases, the manufacturer should maintain appropriate documentation.

4.1.2 Individual assessments

In addition to the requirements of 4.1.1, each CAFS produced by the manufacturer shall meet the requirements of Table 1, which shall be verified by visual inspection, engineering assessment or test, and shall meet the requirements of the tests (see Annex A for guidance on conducting the assessments).

Table 1 — Individual assessment schedule

Assessment	Subclause number
Installation of the CAFS on the vehicle	4.2.2.1
Moving parts	4.2.2.2
Over-pressurization prevention	4.2.3.3
Accumulated water removal	4.2.4.1
Hot parts safety	4.2.5.1
Hot parts notice	4.2.5.2
Electrical equipment safety	4.2.6.2
Operator controls and indicators	4.2.7
Shutdown control	4.2.9
Maintenance and service	4.2.10
Protection against over-speed	4.2.11
Safety from over-heating	4.2.12
Drainage	4.3.1.3
Proportioning ratio and foam solution/air volume ratio	4.3.2.1
Maintenance of proportioning ratio	4.3.2.5
Maintenance of foam solution/air volume ratio	4.3.2.7
Storage vessels	4.3.3
Nominal performance	5.2
Marking	7.1

4.2 Safety and protective measures

4.2.1 General

Safety of machinery shall comply with the requirements of ISO 12100.

4.2.2 Mechanical equipment

4.2.2.1 Installation of CAFS on the vehicle

CAFS shall be so designed and constructed as to be installed on the vehicle, in such a way as to prevent malfunction, disconnection, or damage caused by vibration during operation of the vehicle.

4.2.2.2 Moving parts

4.2.2.2.1 Personnel shall be protected from injury by moving parts during inspection, operation and service. Where applicable, the following shall be provided:

a) fixed guards as defined in ISO 14120, complying with the safety distances defined in ISO 13857;

b) minimum clearance at the end of a motion sequence according to ISO 13854.

4.2.2.2.2 A cautionary notice shall be fitted to, or adjacent to parts that are accessed during inspection, operation and service and may cause injury.

4.2.3 Components under pressure

4.2.3.1 The maximum operation pressure while using CAFS from the designated delivery outlets shall not exceed 1,0 MPa.

NOTE Higher pressures for specific applications might be agreed between users and a manufacturer.

4.2.3.2 A device shall be provided to relieve the internal pressure of the CAFS after operation.

4.2.3.3 Prevention of over-pressurization shall be ensured.

4.2.4 Material, parts and components

4.2.4.1 If water can accumulate in the air system, a means of removing it shall be provided.

4.2.4.2 Material, parts and components shall be resistant to corrosion by the foam concentrate, foam solution and compressed air foam.

4.2.5 Hot parts

4.2.5.1 Personnel shall be protected from injury by hot parts during inspection, operation and service (see ISO 13732-1).

4.2.5.2 A cautionary notice shall be fitted to, or adjacent to parts that are accessed during inspection, operation and service that may cause injury.

4.2.6 Electrical equipment

4.2.6.1 Electrical equipment shall meet the requirements of IEC 60204-1.

4.2.6.2 Design measures shall be taken to protect electrical equipment from damage by water, foam concentrate, and foam solution during filling of storage vessels and operation.

4.2.7 Operator controls and indicators

4.2.7.1 Controls and indicators used by the operator during fire-fighting actions shall be adequately arranged and operated for the purpose of safety, visibility and easier operation [refer to ISO 9335-1, ISO 9335-2, ISO 9335-3 and IEC 61310 (all parts)].

4.2.7.2 Manual operating equipment and other control elements shall be easy to reach and to operate when wearing protective gloves for fire-fighters as specified in ISO 15383 and without having to apply excessive force.

4.2.7.3 The number of switching operations shall be kept to a minimum and the control elements shall be arranged according to the operating sequence, in such a manner that operating errors are minimized.

4.2.8 System failure and continuation of on-going fire-fighting operation

4.2.8.1 Safety-relevant failures in the CAFS shall be clearly indicated.

EXAMPLE Visual indicators on the fire-fighting pump's operating panel, supervision of control valves, etc.

4.2.8.2 Even in case of failure regarding injection of foam concentrate and/or compressed air, the CAFS and the associated installation shall then remain in a safe condition to ensure that further extinguishing operation with water is maintained.

4.2.9 Shutdown control

The operating control station shall be equipped with a control that serves to switch off the system with a single operating step.

4.2.10 Maintenance and service

4.2.10.1 Each part of CAFS shall be easily maintained and serviced.

4.2.10.2 Each part of CAFS which requires lubrication, such as bearings or moving parts shall be easily lubricated.

4.2.11 Protection against over-speed

If necessary, the CAFS shall have a means of preventing maximum speed being exceeded. When the system is switched off, the firefighting pump shall be usable without restrictions and with no user intervention.

4.2.12 Safety from over-heating

A visual or audible alarm shall activate when the temperature of air compressor oil or temperature of compressed air rises above a safe level determined by the manufacturer.

4.3 Performance

4.3.1 Operation

4.3.1.1 CAFS shall be capable of 6 h continuous operation at the nominal compressed air foam delivery rate specified by the manufacturer.

4.3.1.2 Adding foam concentrate while the CAFS is operating shall not cause an interruption in compressed air foam delivery.

4.3.1.3 It shall be possible to drain, the CAFS of water and foam concentrate.

4.3.1.4 CAFS shall operate at ambient temperature ranging from –10 °C to +40 °C.

4.3.2 Proportioning ratio and foam solution/air volume ratio

4.3.2.1 The proportioning ratio and foam solution/air volume ratio may be continuously or incrementally adjustable.

4.3.2.2 The method of setting and selecting the proportioning ratio and foam solution/air volume ratio shall be agreed between user and manufacturer.

4.3.2.3 At nominal foam solution delivery rate, the achievable proportioning ratio shall be not less than 1 %.

4.3.2.4 Across the range of water delivery rates, the proportioning ratio shall be adjustable at least within the range 0,5 % to 1,0 %.

4.3.2.5 The proportioning ratio shall be automatically maintained within the range −0 % to +30 % of the designated value, even when pressure or rate of compressed air foam may change.

4.3.2.6 At the nominal proportioning ratio, the CAFS shall produce wet foam within the compressed air foam delivery rate limits specified by the manufacturer.

NOTE Another specific requirement might be agreed between the user and the manufacturer.

4.3.2.7 The foam solution/air volume ratio shall be automatically maintained or easily manually controlled within ±20 % of the designated value as given in the CAFS description [see 7.2.3 c)].

4.3.3 Storage vessels

4.3.3.1 Storage vessels shall not leak or become deformed during transport, use, or when being refilled.

4.3.3.2 The quantity of foam concentrate in the storage vessel shall be available to the operator.

5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

5.1.1.1 Unless otherwise stated in a test procedure, conduct the testing after the test specimen has been allowed to stabilize in the standard atmospheric conditions for testing as specified in IEC 60068-1 as follows:

— temperature: (15 to 35) °C;

— relative humidity: (25 to 75) %;

— air pressure: (86 to 106) kPa.

5.1.1.2 The temperature and humidity shall be substantially constant for each environmental test where the standard atmospheric conditions are applied.

5.1.2 Mounting arrangements

The specimen shall be mounted by its normal means of attachment in accordance with the manufacturer's instructions. If these instructions describe more than one method of mounting, then the method considered to be most unfavourable shall be chosen for each test.

5.1.3 Operating conditions for tests

5.1.3.1 If a test method requires that a specimen be operational, then the specimen shall be connected to suitable supply and monitoring equipment with characteristics as required by the manufacturer's data. Unless otherwise specified in the test method, the supply parameters applied to the specimen shall be set within the manufacturer's specified range(s) and shall remain substantially constant throughout the tests. The value chosen for each parameter shall normally be the nominal value or the mean of the specified range.

5.1.3.2 The details of the supply and monitoring equipment used shall be given in the test report; see Clause 8.

5.1.3.3 With the exception of foam expansion ratio test, and in the interests of environmental considerations and economy, water may be used as a substitute for foam concentrate during the other tests.

5.1.4 Tolerances

5.1.4.1 Unless otherwise stated, the tolerances for the environmental test parameters shall be as given in the basic reference standards for the test, e.g. IEC 60068-1.

5.1.4.2 If a requirement or test procedure does not specify a tolerance or deviation limits, then deviation limits of ±5 % shall be applied.

5.1.5 Provision for tests

5.1.5.1 The specimen is required to conduct the tests as indicated in the test schedule (see 5.1.6).

5.1.5.2 The specimen submitted shall be representative of the manufacturer's normal production with regard to their construction.

5.1.6 Test schedule

The specimen shall be tested in the order shown and according to the test schedule in Table 2.

Table 2 — Test schedule for CAFS

Test	Subclause
Nominal performance	5.2
Endurance	5.3

The CAFS shall still be in a working condition and in compliance with this part of ISO 7076 after completion of the tests.

5.2 Nominal performance

5.2.1 Object

To demonstrate the CAFS has the performance as designated in Clause 6.

5.2.2 Procedure

5.2.2.1 Mount the specimen as described in 5.1.2 and connect it to supply and monitoring equipment as described in 5.1.3.

5.2.2.2 Operate the specimen in accordance with the manufacturer's specification at the maximum discharge volume and proportioning ratio of 1 %.

5.2.3 Measurements

5.2.3.1 Measure the foam solution delivery rate through 1 min.

NOTE Foam solution delivery rate can be calculated as sum of water delivery rate and foam concentrate delivery rate.

5.2.3.2 Measure the air delivery rate through 1 min.

5.2.4 Requirements

5.2.4.1 Measured value of foam solution delivery rate shall not be less than designated nominal foam solution delivery rate.

5.2.4.2 Measured value of air delivery rate shall not be less than designated nominal air delivery rate.

5.3 Endurance

5.3.1 Object

To demonstrate the ability of the CAFS to operate correctly for an extended period of time.

5.3.2 Procedure

5.3.2.1 Mount the specimen as described in 5.1.2 and connect it to supply and monitoring equipment as described in 5.1.3.

5.3.2.2 Set the proportioning ratio to 1 % or such higher value as nominated by the manufacturer.

5.3.2.3 Operate the CAFS at the maximum discharge volume for 6 h.

5.3.2.4 Do not make any adjustments to the CAFS during the test, except to refill foam concentrate (if used) and fuel.

5.3.3 Measurements

5.3.3.1 Measure the compressed air foam delivery pressure and compressed air foam delivery rate in intervals not exceeding 30 min.

NOTE Compressed air foam delivery rate may be calculated as sum of water delivery rate, foam concentrate delivery rate and air delivery rate.

5.3.3.2 Measure the water delivery rate through 1 min in intervals not exceeding 30 min.

5.3.3.3 Measure the foam concentrate delivery rate through 1 min in intervals not exceeding 30 min.

5.3.3.4 Measure the air delivery rate through 1 min in intervals not exceeding 30 min.

5.3.3.5 Designate the greater of the compressed air foam delivery pressure measured in this test as P_{max} and the lesser as P_{min}.

5.3.3.6 Designate the greater of the compressed air foam delivery rate measured in this test as V_{max} and the lesser as V_{min}.

5.3.4 Requirements

5.3.4.1 No interruption to operation shall occur.

5.3.4.2 No leakage of foam concentrate, water, or compressed air occurs.

5.3.4.3 The ratio of the compressed air foam delivery pressure values $P_{max} : P_{min}$ is not greater than 1,2.

5.3.4.4 The ratio of the compressed air foam delivery rate values V_{max} : V_{min} is not greater than 1,2.

5.3.4.5 The variation of the proportioning ratio shall be within the range −0 % to +30 % of the ratio set at the start of the test.

5.3.4.6 The variation of the foam solution/air volume ratio shall not exceed ±20 % of the ratio set at the start of the test.

6 Designation

CAFS conforming to this part of ISO 7076 shall be designated as follows:

a) long designation;

b) number of this International Standard (i.e. ISO 7076-6:2016);

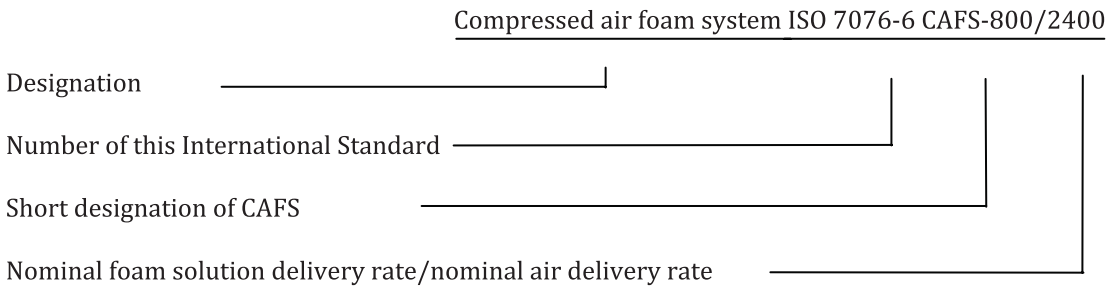
c) short designation CAFS;

d) nominal foam solution delivery rate/nominal air delivery rate.

NOTE 1 Nominal foam solution delivery rate means foam solution delivery rate at the nominal delivery pressure of the CAFS and nominal proportioning ratio of 1 %.

NOTE 2 Nominal air delivery rate means air delivery rate in normal conditions.

EXAMPLE Designation of a compressed-air foam system (CAFS) in accordance with this part of ISO 7076, a nominal foam solution delivery rate of 800 L/min and a nominal air delivery rate of 2 400 L/min:



7 Marking and data

7.1 Marking

7.1.1 The following information shall be permanently marked on the system:

a) the registered name and the full address of the manufacturer and where applicable, of the authorized agent/representative;

b) type, type test number;

c) reference to this standard and the designation;

d) serial number of the CAFS and year of manufacture;

e) at the operating panel/operator's position:

— a diagram showing the system operating range;

— a short-form of the operating instructions.

7.1.2 Marking of control elements and filling devices shall be durable and legible at all times.

7.1.3 Lubrication and servicing points, draining devices etc. shall be identified by appropriate colours.

7.2 Operator instructions

7.2.1 General

7.2.1.1 Information for users shall be compiled in accordance with ISO 12100:2010, 6.4.5 and supplied with each CAFS.

7.2.1.2 Pictograms shall conform to IEC 61310-2. Pictograms which are not included in IEC 61310-2 shall conform to ISO 7000.

7.2.2 CAFS information

The operating instructions shall contain the following general CAFS information:

a) application range and limits of use as intended (e.g. note that the system is not intended for use in potentially explosive atmospheres), including specification of all ambient conditions at the place of deployment;

b) details on the CAFS, including:

   1) manufacturer's name or name of their authorized representative,

   2) designation, type, size,

   3) revision number and/or revision date of the operating instructions,

   4) warnings to prevent foreseeable misuse;

c) necessary personal protective equipment (e.g. the need to wear protective gloves in accordance with ISO 15383).

7.2.3 Description

The operating instructions shall contain the following descriptions:

a) general description;

b) ambient temperature range for system operation;

c) design, mode of operation and system performance, including main specifications;

d) following information about the properties of the foam concentrate that must comply with to be used with the system:

   1) proportioning ratio;

   2) viscosity;

e) information concerning the hoses (e.g. diameter, length) and the nozzles to be used;

f) maximum operating pressure;

g) information on operating elements, indicators and displays;

h) design, operating principle and use of protective devices;

i) additional description of accessories;

j) cutaway or exploded view drawings of the system as required by the party ordering the system;

k) information on the electrical equipment.

7.2.4 Commissioning, operating and decommissioning

The operating instructions shall include the following instructions for commissioning, operating and decommissioning the system:

a) technical documents, including:

   1) measuring points and piping diagram (e.g. piping and instrumentation flow diagram);

   2) overview of recommended lubricants;

b) settings of control and monitoring equipment, including:

   1) function tests;

   2) setting values;

c) instructions for putting the system into operation, including:

   1) commissioning;

   2) putting system into operation after interruptions;

   3) switching the system on/number of switching cycles;

   4) operation and starting-up with closed valve;

   5) operating characteristics with increased inlet pressure;

   6) special information (e.g. readiness for operation, disturbances);

d) decommissioning, including:

   1) switching off the system;

   2) emptying and draining;

   3) flushing procedures (time, volume, pressure, etc.);

   4) preservation;

e) other measures determined by the manufacturer required for the safe and complete operation of the CAFS.

7.2.5 Servicing and maintenance

The operating instructions shall include the following system servicing and maintenance instructions:

a) maintenance intervals and extent of maintenance work;

b) maintenance and inspection tasks including:

   1) consumables including a list of replacement parts and special tools;

   2) monitoring during operation;

   3) preventive measures (e.g. for parts subject to wear, lubrication, sealing medium);

4) warning against risks arising from incorrectly set safety devices;

c) tightening torques for connecting elements;

d) criteria for selecting parts needing replacement;

e) durability of markings and warning notices.

7.2.6 Fault causes and corrections

The operating instructions shall include the following instructions on determining causes and corrective measures in case of faults:

a) faults, including:

1) hydrodynamic faults;

2) mechanical faults;

3) electrical faults;

4) faults in measuring instruments and their connections;

b) correction of faults and elimination of faults on the basis of a product-specific checklist.

7.2.7 Other technical documents

Where agreed by the manufacturer/authorized representative and the party ordering the CAFS, other technical documents shall be supplied.

7.2.8 Short-form operating instructions

Short-form operating instructions with the following information shall be provided in a weather-resistant form (legibly and indelibly) that can be readily used by operators on site. This part of ISO 7076 shall include information on

a) commissioning,

b) settings/operation without supervision,

c) decommissioning, and

d) operating range.

8 Report

The report of type approval tests of CAFS shall contain at least following information:

a) manufacturer’s name or trademark;

b) reference to this part of ISO 7076, i.e. ISO 7076-6:2016;

c) designation of the CAFS;

d) identification of the CAFS assessed;

e) details of the supply and monitoring equipment;

f) results of assessments and tests;

g) date of test;

h) name and function of the person(s) conducting the tests.

Annex A
(informative)

Guidance on the inspection and testing of CAFS

A.1 General

A.1.1 Guidance is provided for the inspection and test of CAFS. The guidance shown in Table A.1 includes the assessment items listed in Table 1 and may be applied to both the type assessments, as required in 4.1.1, and individual assessments, as required in 4.1.2.

A.1.2 When tests are conducted, appropriate, calibrated test equipment should be used. The calibration and use of test equipment should be controlled in accordance with a recognized quality system.

A.1.3 This part of ISO 7076 does not include a requirement for third-party assessment of CAFS. The assessment may be undertaken by the manufacturer; however, first-party assessment may not satisfy the requirements of local regulations or specific customers.

Table A.1 — Guidance for individual requirements

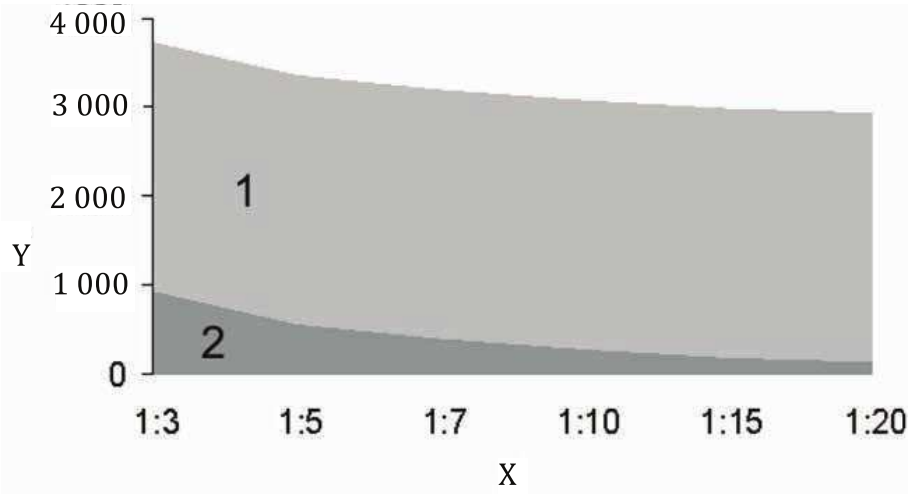
Subclause number	Type assessment	Individual assessment	Comments
4.2.2.1	Inspection of design documentation and visual inspection of the installed CAFS.	Visual inspection of the installed CAFS.	A test run may assist in checking for unusual vibrations.
4.2.2.2	Inspection of design documentation and visual inspection of the installed CAFS.	Visual inspection of installed CAFS and installed safety devices.	When not yet installed in a vehicle, additional data may be required to confirm compliance.
4.2.3.3	Inspection of design documentation and installed CAFS.	Visual inspection of installed CAFS and safety devices.	For example, check that properly rated relief valves are installed. Run CAFS to see if hazardous situations can be avoided by other means.
4.2.4.1	Inspection of design documentation and installed CAFS.	Inspection of documentation and visual inspection of CAFS.	CAFS may avoid water accumulation as part of the design or with the provision of automatic means to release accumulated water.
4.2.5.1	Inspection of documentation, design and installed CAFS.	Visual inspection of installed CAFS and inspection of parts ratings in the data.	The surface temperatures may be measured if required.
4.2.6.2	Inspection of documentation, design and installed CAFS.	Visual inspection of installed CAFS.	Splash testing, if undertaken, should be representative of what may happen in use.
4.2.7	Inspection of design and installed CAFS.	Functional check.	A typical operation test may be sufficient for the individual assessment.
4.2.9	Inspection of documentation. Inspection of design and installed CAFS.	Functional test.	—

Table A.1 *(continued)*

Subclause number	Type assessment	Individual assessment	Comments
4.2.10	Inspection of documentation and design. Inspection of installed CAFS.	Inspection of documentation. Visual inspection of installed CAFS.	Maintenance and service points should be identified in the manual.
4.2.11	Inspection of documentation and design. Inspection of installed CAFS.	Inspection of documentation. Inspection of installed CAFS.	Precautions may be necessary if a component (for example compressor) exceeds critical speeds during operation.
4.2.12	Inspection of documentation. Inspection of installed CAFS. Endurance test within type test program.	Check documentation. Check installed CAFS.	While operating under normal conditions, no overheat situation should occur, so simulating the alarms may be necessary.
4.3.1.3	Check design. Inspection of installed CAFS.	Visual inspection of installed CAFS.	Access to drain controls and drain outlets should be reasonable for users.
4.3.2.1	The manufacturer declares the operating range of the CAFS in terms of intended: — water delivery rates; — air delivery rates; — foam concentrate delivery rates; — foam solution/air volume ratios to be achieved. The confirmed data can be shown in a chart (see Figure A.1). The accuracy of proportioning ratio is tested over the operating range (foam solution delivery rate) identified by the manufacturer which includes the nominal performance point. The proportioning ratio during these tests should be the nominal proportioning ratio (1 %) and half of the nominal proportioning ratio. If the CAFS comprises flow meters, their calibration and accuracy should be checked at the nominal performance point and at half the nominal performance point.	Confidence points may be checked and should include the following: — accuracy of proportioning ratio; — at nominal delivery rate and nominal proportioning ratio; — At half the nominal delivery rate and half the nominal proportioning ratio; — delivery rates and achieved expansion ratio; — at nominal delivery rate (for wet foam); — at the lowest delivery rate (for dry foam). A typical assessment could be to first check the calibration and the accuracy of the flow measurement. Test points may be nominal delivery and half of the nominal delivery rates. Test nozzles or other recognized test procedures should be used.	The accuracy of proportioning ratrio can be tested for example by pumping water or simulating water flow and pumping the foam concentrate into a calibrated container over a defined period of time. Data on the expansion ratio should be documented. The proportioning ratio during the expansion tests should be adjusted according to data from the foam concentrate manufacturer. These data should be are recorded with the test results. The results of individual CAFS assessments may be usefully compared to the results from the type assessment. If the CAFS recognizes actual foam solution/air volume ration during operation, foam expansion ratio test can be omitted in individual assessment.
4.3.2.5	The procedure in general is the same as for 4.3.2.1. Data should be recorded before the endurance test. After the endurance test, the confidence points required for the individual assessment should be checked.	Same as for 4.3.2.1.	During the endurance test, foam agent may be recirculated into the CAFS tank or substituted by water.

Table A.1 *(continued)*

Subclause number	Type assessment	Individual assessment	Comments
4.3.2.7	The test could be conducted before the endurance test. Confidence points for the individual assessment should be checked during the endurance test.	Same as for 4.3.2.1.	If foam injection is simulated during the endurance test, test hoses may show severe reaction from air pockets being transported along the hose. Suitable test hoses, securely connected to fixed pipes in the test well should be used.
4.3.3	Inspect of documentation and installation.	Inspect documentation and visual inspection of installed CAFS.	The operator instructions should include certification or recertification procedures if required for pressure vessels.
5.2	CAFS should be operated at no less than the nominal duty point for the duration test.	Check confidence points. Nominal performance is one confidence point.	—
7.1	Inspection of documentation and installation.	Inspection of documentation and installation.	—



Key

X foam solution/air volume ratio
Y compressed air foam delivery rate (L/min)
1 air
2 foam solution

Figure A.1 — Example of operating range of CAFS

A.2 Foam expansion ratio determination procedure

A.2.1 Confirmation of conformance with 4.3.2.1 should include recording the following data:

— ambient conditions (including temperature, barometric pressure, air speed, humidity);

— foam concentrate and proportioning ratio;

— foam solution and air delivery rate (air delivery rate may be obtained from compressor documentation);

— type and size of nozzle used;

Straight bore nozzles may be more beneficial for testing CAFS than fog nozzles, so a straight nozzle should be used as a reference. Dry foam can only be tested with straight bore nozzles. The nozzle diameter should match the CAFS performance, but should be no small than 19 mm diameter. A typical hand-held test nozzle is 25 mm diameter with a straight bore and has been well proven to test general CAFS functionality. Larger nozzles may be used in conjunction with a portable monitor.

— hose configuration;

— CAFS operation pressure;

The CAFS and foam should be allowed to stabilize for at least 30 s before taking the first sample.

Three or four samples should be taken per test point on the CAFS. Because the type assessment includes the full range of flows and ratios declared by the manufacturer, the individual assessment may choose the nominal performance setting and one other setting (e.g. full wetting or selected by the customer). If the CAFS uses multiple mixing chambers, all of them should be tested.

— distance from collector and angle of the nozzle.

A.2.2 The expansion ratio should be calculated using the Formula (A.1):

$$E = \frac{V}{V_n} \tag{A.1}$$

where

E is the expansion ratio;

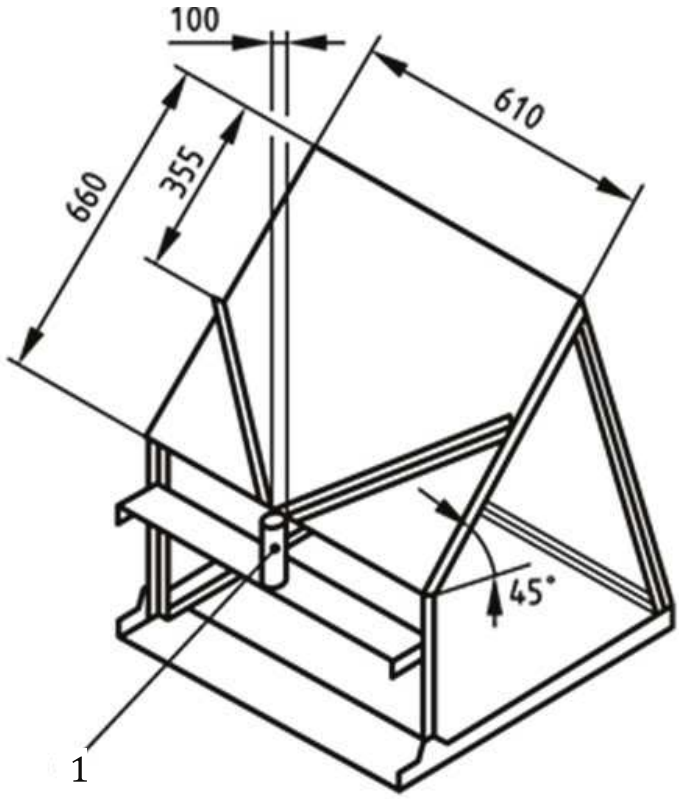
V is the content of the container;

V_n is the net content of the sample collected.

The contents of the container may be found by subtracting the weight of an empty container from the weight of a water full-filled container. The net content of the sample collected may be found by subtracting the weight of the empty container from the weight of container with the sample.

A.2.3 The distance between the nozzle and the collector should be arranged, in such a way that the discharge stream gently rains down onto the collector. The container used to collect the finished foam should have a capacity of 1 L to 3 L. Figure A.2 shows a typical collector for the finished foam.

Dimensions in millimetres

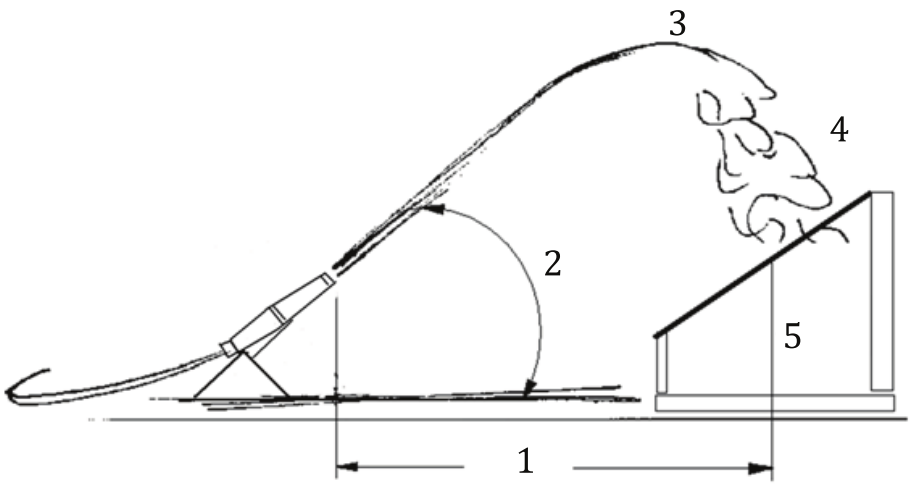


Key

1 drainage pot

Figure A.2 — Collector for finished foam

A.2.4 Changes should not be made to the nozzle (including closing the nozzle) between samples. It is preferable to direct the stream away from the tray temporarily while changing the container. Figure A.3 shows a typical arrangement of nozzle and collector during the test.



Key

1 distance between nozzle and collector
2 angle of the nozzle
3 break over
4 rain down
5 collector according to Figure A.2

Figure A.3 — Typical nozzle and collector arrangement

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