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PROPERTY INSURANCE COMMITTEE
Prevention Specifications

CEA Specifications for inert gas fire- fighting systems Requirements and test methods for Nozzles

CEA 4016: February 2000 (en)

(EFSAC endorsed)

Contents

1 Scope and field of application

These CEA Specifications specify requirements and describe test methods for room protection nozzles which introduce the gaseous extinguishing agent into a protected hazard. The design of the nozzles will influence the discharge rate, the distribution characteristic of the nozzle and the pressure drop in the piping network.

These CEA Specifications should only be used as guidance for testing nozzles which work on different principles.

All pressure data in these CEA Specifications are given as gauge pressure in bar, unless otherwise stated.

2 References

These CEA Specifications incorporate by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to these CEA Specifications only when incorporated in them by amendment or revision. For undated references the latest edition of the publication referred to applies.

- CEA Specifications for Inert Gas-Systems - Planning and Installation

3 Definitions

For the purpose of these CEA Specifications the following definitions apply.

cross section:
Total area of all smallest geometrical single areas.

design pressure:
Pressure in the container at 15 °C

distribution characteristic:
Volume in which the gaseous extinguishing agent is distributed uniformly from a nozzle.

filter:
A component to prevent blockage of nozzles with small orifices.

flow rate:
Mass flow of gaseous extinguishing agent against time.

functional reliability:
Ability to function under different working conditions.

nozzle:
A component to achieve a predetermined flow rate and a uniform distribution

characteristic of the gaseous extinguishing agent into or onto a protected hazard.

nozzle cover:
A component to protect nozzles against exterior dirt.

operational reliability:
Resistance against wear.

room protection nozzle:
A nozzle, from which the gaseous extinguishing agent is discharged for the distribution throughout an enclosure.

test sample:
Component or assembly of components to test.

working pressure:
The highest possible pressure in the component.

4 Requirements

4.1 Material

The nozzle and internal parts shall be made of metal.

All components shall be resistant to media with which they come into contact.

The function of the nozzle shall not be adversely affected by ageing or environmental influences.

4.2 Connection threads

Connection threads shall comply with European standards, European national standards or ISO- standards.

4.3 Nozzle opening cross section

The minimum dimension of any individual discharge opening of the nozzle shall not be smaller than 1 mm.

Nozzles with dimensions of discharge openings ≥ 3 mm shall not be equipped with a filter. Nozzles with dimensions of discharge openings < 3 mm shall be equipped with a filter.

The filter shall be made of corrosion resistant metal. The unrestricted filter surface area must be at least five times the nozzle cross section. The mesh of the filter shall be between 0,5 mm and 0,8 mm, measured in the plane of the hole.

4.4 Nozzle protection covers

If the nozzle opening is protected against exterior dirt with a cap or similar cover, this cover shall eject clear of the nozzle's full opening cross section at extinguishant pressures between 0,1 bar and 3 bar when tested as described in clause 5.7. The cover shall not affect extinguishant distribution.

Note The design of the nozzle cover should prevent the formation of a layer of material such as paint which could considerably hinder the correct opening of the nozzle.

4.5 Flow rate

The manufacturer shall submit a formula which describes the flow rate of the nozzle in kg agent per second in the pressure range from 2 bar to the working pressure and in the temperature range -50 °C to 30 °C.

Where filters are installed, these shall be taken into account when determining the flow rate.

The performance characteristics shall be tested as described in clause 5.5.

4.6 Distribution characteristic

The distribution of gaseous extinguishing agent shall be tested as described in clause 5.4.

4.7 Pressure and heat resistance

The extinguishing nozzles shall be able to withstand the working pressure at a temperature of 600 °C.

Following testing for pressure and heat resistance as described in clause 5.6, the nozzles shall show no signs of deterioration which could impair proper performance.

4.8 Corrosion

The performance of the nozzles shall not be adversely affected as a result of the corrosion test as described in clause 5.8.

4.9 Stress corrosion

Any copper alloy part used in nozzles shall not crack, when tested as described in clause 5.9.

4.10 Vibration

Nozzles assembled from several parts shall not be damaged, when tested as described in clause 5.10.

4.11 Impact

Following the test as described in clause 5.11 the nozzle shall show no signs of damage which could impair the proper function.

4.12 Marking and data

Nozzles shall be marked with the following information:

a) the markings required by European or National Standards and

b) manufacturers or suppliers name or trademark and

c) model designation/size and

d) serial or batch number

The marking shall be non-detachable, non-flammable, permanent and legible.

4.13 Documentation

4.13.1 The manufacturer shall prepare and maintain documentation which specifies the installation, operation, routine testing and maintenance of the nozzle and all other aspects relating to its incorporation within a fire extinguishing system.

4.13.2 The documentation shall be submitted to the testing authority and shall comprise at least the following:

a) a general description of the equipment, including a list of the features and functions.

b) a technical specification including:

- the working pressure
- the suitability for use in various environments
- mounting instructions

c) maintenance instructions

4.13.3 The manufacturer shall also prepare, maintain and submit the following detailed documentation:

- description of the overall mechanical design including
  - the main parts of the nozzle and their tasks
  - the way in which the parts interact
  - component lists
  - layouts
  - design drawings
  - special information of manufacturing details which influence the flow characteristics (e.g. inlet of orifice plates)

This documentation shall also comprise details of any components specific to the manufacturer.

4.13.4 All documentation normally supplied by and specified by the manufacturer for use by the end user shall be supplied with the device and constitute part of the supply.

5 Tests

5.1 Test conditions

The components shall be tested assembled as recommended for installation by the manufacturer. The tests shall be carried out at a temperature of (25 ± 10) °C, except when otherwise stated.

5.2 Test samples and order of tests

When testing a nozzle type with only one size, four test samples A, B, C, D are needed. The order of tests is shown in table 1.

Table 1: Order of tests for one size				
Test sample	**A**	**B**	**C**	**D**
5.3 Compliance	1	1	1	1
5.4 Distribution characteristics			2	
5.5 Flow rate	2/4			
5.6 Pressure and heat		2		
5.7 Nozzle cover				2
5.8 Corrosion	3			
5.9 Stress corrosion				3
5.10 Vibration			3	
5.11 Impact			4	

When testing a series of identical design, three test samples A, B, C of three different sizes 1, 2, 3 (bottom, middle and top end of range) and one test sample of the other sizes, but maximum of five other sizes, will be required. The order of tests is shown in table 2.

Table 2: Order of tests for a series					
Test sample	**A1**	**B1**	**A2**	**A3**	**other**
5.3 Compliance	1	1	1	1	1
5.4 Distribution characteristics	2 [1)]		3 [1)]	3 [1)]	
5.5 Flow rate		3/5	2	2	
5.6 Pressure and heat				4	
5.7 Nozzle cover		2			
5.8 Corrosion		4			
5.9 Stress corrosion	3				
5.10 Vibration			4		
5.11 Impact			5		

1) Only one of the nozzle sizes is selected in accordance to the relation to the volume of the test room (see clause 5.4)

5.3 Compliance

A visual inspection and measurement check shall be made to determine whether the test samples correspond to the description in the technical literature (drawings, parts lists, description of functions, operating and installation instructions), and whether the samples comply with these CEA Specifications.

5.4 Distribution characteristic

This test relates to the requirements of clause 4.6.

For testing the distribution characteristic with one or more nozzles in a test room the following test conditions shall be set up:

a) Relative humidity in the test room:
(60 ± 5) %.

b) Test medium:
the extinguishing agent

b) Flooding mass:
a mass which gives an Oxygen-reduction from 20,8 Vol-% to (13 ± 1) Vol-% in the test room

c) Start-pressure in the supply container:
design pressure of the system -5/+0 bar, but maximum 50 bar

d) Pressure at the nozzle during the tests:
in the range of 50 % to 75 % of the pressure in the supply container

e) Flooding time:
(60 ± 5) s

f) Supply mass:
maximum 120 % of the flodding mass

Oxygen concentration measurements shall be made to determine whether the test gas is distributed evenly in the volume served by the nozzle(s). The deviation of the concentration of the different measuring points shall be at maximum 0,7 Vol-% Oxygen (60 ± 10) s after the end of the discharge. The test set-up is shown in figure 1. The pressure relief opening shall be closed when the flooding mass has been discharged.

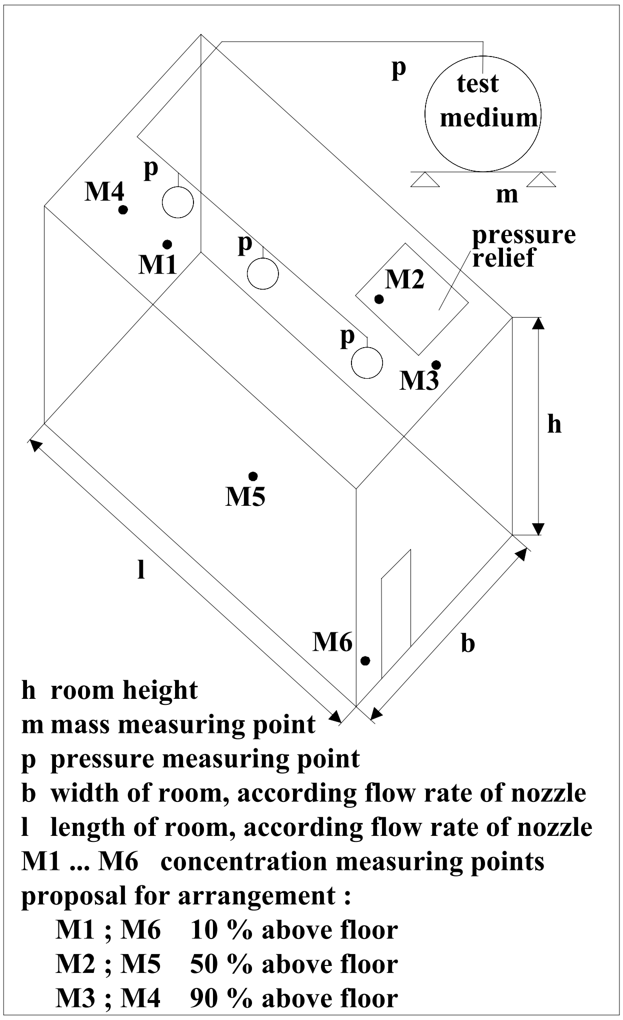

Figure 1: Test configuration for room protecting nozzles

5.5 Flow rate

This test relates to the requirements of clause 4.5.

Checks shall be made to determine whether the test samples comply with the flow rate indicated by the manufacturer. Deviations may not exceed ±10 %. The test set-up is shown in Figure 2.

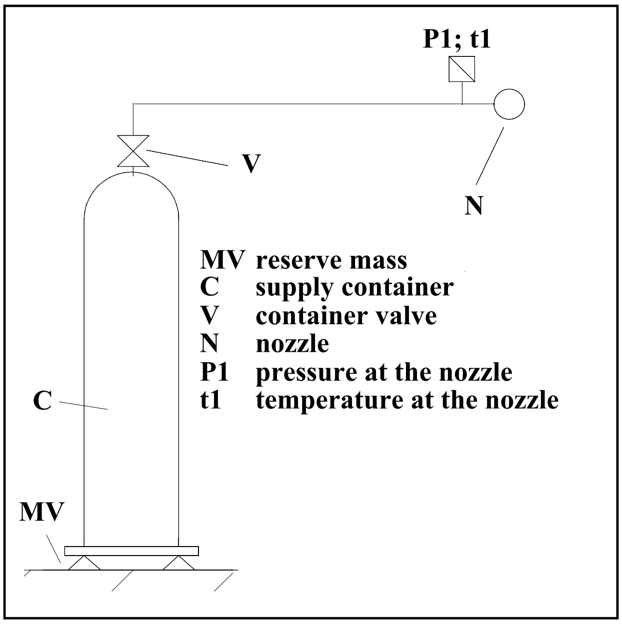

Figure 2: Test configuration for flow rate test

5.6 Pressure and heat resistance

This test relates to the requirements of clause 4.7.

A nozzle is connected to a test vessel delivering a pressure of the working pressure of the nozzle. The nozzle, placed in a furnace, is subjected to a temperature of (600 ± 30) °C for a period of (10 +2/-0) min. Then Nitrogen or air is passed through the heated nozzle body for at least 10 s.

The test configuration is shown in Figure 3.

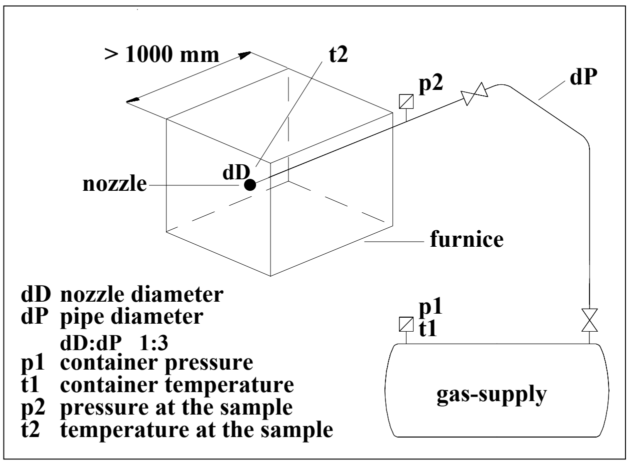

Figure 3: Test configuration for pressure and heat resistance test

5.7 Nozzle protection cover

This test relates to the requirements of clause 4.4.

The nozzle with cover shall be mounted on pipe equipped with a pressure gauge. The pressure in the pipe shall be raised by (1 +0,1/-0) bar/min. The pressure required to open the cover shall be measured.

5.8 Corrosion

The test relates to the requirements of clause 4.8.
A sample shall be suspended freely in its normal installation attitude.
The test set-up comprises a container 5 litres in volume, made of heat-resistant glass and with a corrosion-resistant cover which is shaped to prevent condensate dripping onto the samples. (If a container 10 litres in volume is used, the quantities of chemicals given below shall be doubled.)
The container is heated electrically and the side walls are cooled with water. A thermostat regulates the heating so as to maintain a temperature of approximately 45 °C inside the container. During testing water is passed through a cooling coil wrapped around the container; it should flow fast enough that its temperature at the discharge point is below 30 °C.
The combination of heating and cooling is designed to insure that vapours will condense on the surface of the samples.
The sulphur dioxide atmosphere is generated in the 5-litre container with a solution of 20 g of sodium thiosulphate ($Na_2S_2O_3 \times 5H_2O$) in 500 cm^3 of distilled water, to which 20 cm^3 of dilute sulphuric acid is added daily. The dilute sulphuric acid comprises 128 cm^3 of one molar sulphuric acid (H_2SO_4) dissolved in 1 litre of distilled water. The test samples shall be removed from the container after 8 days; the container shall be cleaned. Then the procedure described above is repeated for a further period of 8 days.
After a total of 16 days, the samples are removed from the container and allowed to dry for seven days at a temperature of (20 ± 5) °C at maximum relative humidity of 70 %.

5.9 Stress corrosion

The test relates to the requirements of clause 4.9.
Use a suitable container of known volumetric capacity fitted with a capillary tube vent. The aqueous ammonia solution shall have a specific weight of 0.94 kg/l ± 2 %. The container is filled with (10 ± 0,5) ml of the solution for each litre of container volume.
Degrease the sample for test and expose for 10 -0/+1 days to the moist atmosphere of ammonia and air, at a temperature of (34 ± 2) °C. The samples are positioned (40 ± 5) mm above the level of the liquid.
After testing, the samples are cleaned and dried and subjected to careful visual examination. Any cracking shall be clearly apparent.

5.10 Vibration

This test relates to the requirements of clause 4.10.
The sample is attached to a vibration table using fixing materials provided by the manufacturer.
The sample is then subjected to sine-wave vibration in all three axes, in a range of from 10 Hz to 150 Hz. The frequencies are raised uniformly at a rate of one octave every 30 minutes. The vibration acceleration is 1 g in the frequency range from 10 Hz to 50 Hz and 3 g in the frequency range from 50 Hz to 150 Hz.
No deterioration or detachment of parts shall occur. The samples shall be able to function after the vibration test.

5.11 Impact

The test relates to the requirements of clause 4.11.
Impact testing is used to determine whether the nozzle is sufficiently resistant to impact loads.
The nozzle is suspended from the impact mechanism as shown in Figure 4. A horizontal blow is then delivered to the nozzle, at an energy level of 2,6 Joule, hammer head velocity of (1,8 ± 0,15) m/s. The impact surface of the hammer head shall be at a (60 ± 3)° angle to the nozzle's vertical axis at the moment of impact.

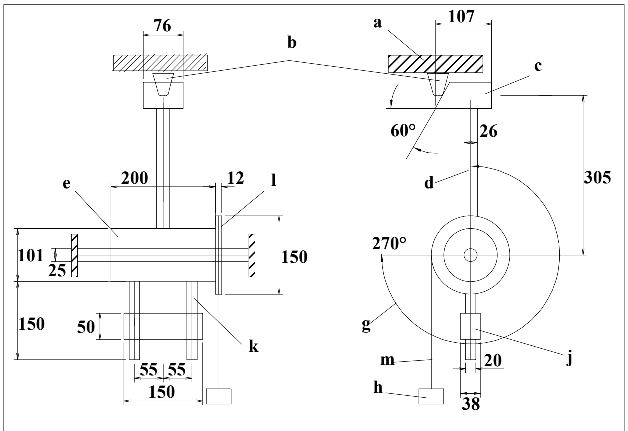

Figure 4: Impact test configuration

The test configuration comprises essentially a rotating hammer with a head made of aluminium having a rectangular cross section and sloped impact surface; it is mounted on a round steel shaft.

The shaft of the hammer is affixed to a hub which rotates on ball bearings around the axis of a fixed steel shaft, so that the hammer can rotate freely around the axis of the fixed shaft. The rigid frame is designed so that the hammer can make a complete revolution if no nozzles are present.

The hammer head is 76 mm wide, 50 mm deep and 94 mm long (overall dimensions). It has a flat impact surface which is sloped at an angle of (60 ± 1)° to the long axis of the hand. The round steel shaft has an outside diameter of (25 ± 0,1) mm. The hammer is mounted on the shaft in such a way that its longitudinal axis is at a distance of

300 mm from the centre line of the unit, whereby the two axes are perpendicular one to the other. The hub has an outside diameter of 100 mm, a length of 200 mm and is mounted coaxially to the fixed steel shaft, which has a diameter of 25 mm.

There is a steel counterweight opposite the hammer, attached to the hub with two steel arms. These arms are bolted to the hub in such a way that 150 mm of their length is exposed. The counterweight is attached in such a way that it can be shifted to balance out the weight of the hammer. At the end of the hub there is a pulley 12 mm wide, 150 mm in diameter, made of aluminium. Around it is wrapped a non-stretchable cable, one end of which is attached to the pulley. The other end is attached to a weight.

The rigid frame also carries a mounting plate to which the nozzle is attached. This mounting plate can be adjusted along the vertical axis so that the centre point of the hammer impact surface strikes the nozzle when the hammer is moving through the apex of its arc (i.e. quasi-horizontal motion).

The unit is operated by first adjusting the position of the nozzle and the mounting plate. The hammer unit is then carefully balanced by adjusting the counterweight. The drive weight is detached while doing so. The shaft of the hammer is rotated back though 270°, to the horizontal, and the drive weight is attached. When released, the drive weight rotates the hammer and its shaft through a 270° arc.

The mass of the drive weight for this configuration is 0,552 kg 3 r whereby the actual radius of the pulley is given in metres. This corresponds to approximately 0,78 kg when using a pulley with a radius of 0,075 m.

Since a hammer velocity of

(1,8 ± 0,15) m/s is specified at the moment of impact, it may be necessary to drill out the rear face of the hammer in order to achieve the required velocity. Tests shall be made to determine that the device is working properly.