BS EN 14972-11:2023

BSI Standards Publication

Fixed firefighting systems — Water mist systems

Part 11: Test protocol for cable tunnels for open nozzle system

bsi.

National foreword

This British Standard is the UK implementation of EN 14972-11:2023.

The UK participation in its preparation was entrusted to Technical Committee FSH/18/5, Watermist systems.

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

BSI, as a member of CEN, is obliged to publish EN 14972-11:2023 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK committee advised against its approval.

It is the view of the UK committee that some of the requirements in EN 14972-11:2023 are suboptimal to the recommendations in the BS 8489 series and to the protocols that have been in use in the UK to date.

The UK committee also has a concern to the degree of reliance on the design, installation, operation and maintenance (DIOM) manual to constrain critical parameters with regard to the whole EN 14972 series of documents.

The UK committee also has concerns about a number of other aspects of EN 14972-11:2023. The UK committee believes that the standard does not sufficiently cover certain technical and safety matters. These have been addressed to some extent in the national annexes to BS EN 14972-11:2023, which are appended at the back of this document.

The limits of application of the fire test protocols and other constraints have not, at the time of writing, been published. The intended scope and clear limits of the fire test protocols to the application of this standard are fundamental to its safe implementation. National Annexes NA and NB contain the UK committee recommendations (i.e. mechanisms to declare and constrain limits of application).

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Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

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May 2023

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English Version

Fixed firefighting systems - Watermist systems - Part 11: Test protocol for cable tunnels for open nozzle systems

Installations fixes de lutte contre l'incendie - Systèmes à brouillard d'eau - Partie 11 : Protocole d'essai des systèmes à buses ouvertes pour galeries de câbles

Ortsfeste Brandbekämpfungsanlagen - Wassernebelsysteme - Teil 11: Prüfprotokoll für Kabeltunnel für offene Düsensysteme

This European Standard was approved by CEN on 17 April 2023.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN 14972-11:2023 E

Contents

European foreword

This document (EN 14972-11:2023) has been prepared by Technical Committee CEN/TC 191 "Fixed firefighting systems", the secretariat of which is held by BSI.

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 November 2023, and conflicting national standards shall be withdrawn at the latest by November 2023.

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

The EN 14972 series, published under the general title *Fixed firefighting systems — Water mist systems*, consists of the following parts. This list includes standards that are in preparation, and other standards can be added. For the current status of published standards, refer to www.cencenelec.eu.

— *Part 1: Design, installation, inspection and maintenance*;

— *Part 2: Test protocol for shopping areas for automatic nozzle systems*;

— *Part 3: Test protocol for office, school classrooms and hotel for automatic nozzle systems*;

— *Part 4: Test protocol for non-storage occupancies for automatic nozzle systems*;

— *Part 5: Test protocol for car garages for automatic nozzle systems*;

— *Part 6: Test protocol for false floors and false ceilings for automatic nozzle systems*;

— *Part 7: Test protocol for commercial low hazard occupancies for automatic nozzle systems*;

— *Part 8: Test protocol for machinery in enclosures exceeding 260 m^3 for open nozzle systems*;

— *Part 9: Test protocol for machinery in enclosures not exceeding 260 m^3 for open nozzle systems*;

— *Part 10: Test protocol for atrium protection with sidewall nozzles for open nozzle systems*;

— *Part 11: Test protocol for cable tunnels for open nozzle systems*;

— *Part 12: Test protocol for commercial deep fat cooking fryers for open nozzle systems*;

— *Part 13: Test protocol for wet benches and other similar processing equipment for open nozzle systems*;

— *Part 14: Test protocol for combustion turbines in enclosures exceeding 260 m^3 for open nozzle systems*;

— *Part 15: Test protocol for combustion turbines in enclosures not exceeding 260 m^3 for open nozzle systems*;

— *Part 16: Test protocol for industrial oil cookers for open nozzle systems*;

— *Part 17: Test protocol for residential occupancies for automatic nozzle systems*.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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1 Scope

This document specifies fire testing requirements for water mist systems used for fire protection of cable tunnels. The test protocol covers deluge water mist systems with open nozzles which are either activated with an automatic release system, e.g. fire detection system, or manually released.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 13501-1:2018, *Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests*

EN 14972-1:2020, *Fixed fire fighting systems - Water mist systems – Part 1: Design, installation, inspection and maintenance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14972-1 apply.

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

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

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

4 General requirements

4.1 Up to a maximum of 5 nozzles used in the fire tests shall be kept for later verification.

4.2 The water mist system, operating without manual intervention, shall successfully complete all described performance fire tests.

4.3 The fire load shall be taken from the conditioning area and arranged into the test area just before conducting the test.

4.4 The water flow shall be shut-off 15 min after the activation. After turning off the system, no more than small localized flamelets on a single tray and no smouldering are allowed and the fire damages shall be recorded.

4.5 Prior to the testing, a layout of the water mist system to be tested shall be submitted for test preparation purposes. This layout shall include any components required for the testing as well as the full dimensioning (e.g. length of pipes, distances of nozzles, etc.).

4.6 System components, component locations, operating conditions and test enclosure details shall remain unaltered throughout all of the fire tests for a given application.

4.7 All fire tests shall be conducted using the manufacturer instructions in regard to nozzle placement, spray flux, and operating pressure. Sprays shall not be intermittent.

4.8 The water supply shall be capable of supplying a flow rate and pressure at the minimum operating pressure and flow rate of the open nozzle as specified by the manufacturer. These parameters shall be met based on the actual layout of the pipework installation as used in the test scenario.

4.9 The tests with the water mist system shall be conducted at maximum spacing and minimum discharge conditions regarding water flow and pressure as specified by the manufacturer for this application. The system shall be installed to achieve the maximum allowed time delay of water pressure build-up of the system.

5 Fuel packages

5.1 General

The test assembly to be provided for the tests by the applicant shall comply with the following specifications and figures.

The test scenario is based on a typical tunnel layout comprising the appropriate fire load in terms of cabling.

The test assembly shall include the following elements:

a) test tunnel enclosure;

b) cable trays;

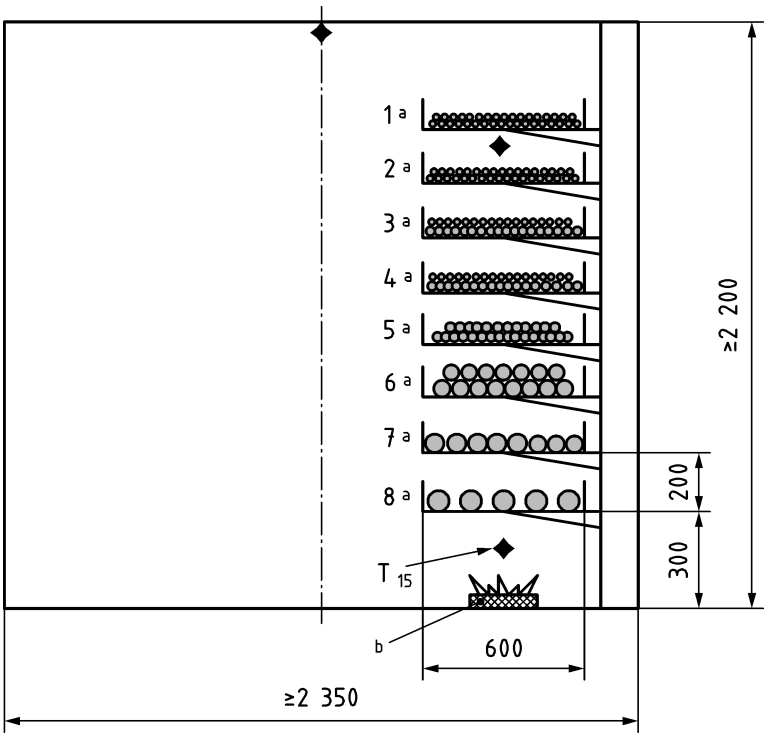
c) cables fire load;

d) ignition source;

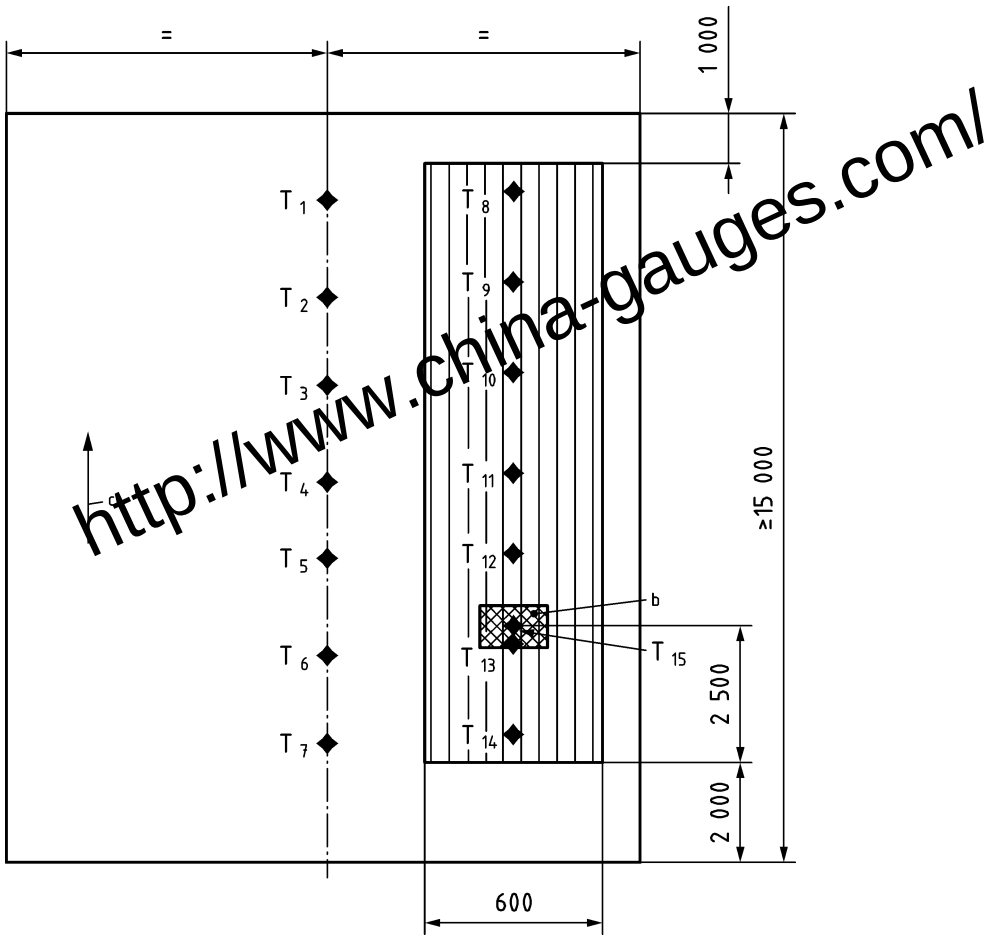
e) ventilation.

Figure 1 shows an example of the test assembly in accordance with the requirements specified in this clause.

Dimensions in millimetres



a) side view



b) top view

Key

a	tray	◆	thermocouple (T)
b	propane gas burner	○	cable
c	air flow: 1 m/s		

Figure 1 — Minimum dimensions of fire test enclosure with arrangement of cable trays and water mist nozzles

5.2 Tunnel enclosure

The maximum cable tunnel enclosure width and height (as specified by the manufacturer) shall be tested meeting the minimum requirements described below.

The enclosure shall be constructed of non-combustible material (class A1 in accordance with EN 13501-1:2018).

The minimum size of the enclosure shall be as follows:

— Height: Minimum 200 mm above the top tray, but at least 2 200 mm;

— Width: Minimum 2 350 mm;

— Length: Minimum tunnel length 18 000 mm. Given by the minimum length of cable trays required to be able to detect at least 500 mm of undamaged cables at both ends (minimum 15 000 mm) plus 2 000 mm at the side of air entrance and 1 000 mm at the side of air outlet.

All machinery needed to establish the ventilation shall be placed outside of the above described minimum length.

5.3 Cable tray arrangement

The cable trays shall be of non-combustible material (class A1 according to EN 13501-1:2018).

The cable trays shall be of open ladder type or of similar construction. The cable trays shall not have a solid base.

The position of the tray nearest to the floor shall be at least 300 mm above floor.

The cable trays shall have a width of at least 600 mm. The use of cable trays with a greater width is up to the manufacturer.

The vertical distance between two cable trays shall be 200 mm.

The horizontal distance between the cable trays and the wall of the enclosure shall be 200 mm.

The test can be carried out either with one stack of cable trays on one side of the cable tunnel enclosure or with two stacks of cable trays on both sides of the enclosure.

Arrangements of more cable trays above each other are up to the manufacturer.

5.4 Cable fire load

The fire load shall consist of cables with different dimensions.

For greater fire loads, the distribution percentage of different cable sizes shall be retained. Cables with larger diameters shall preferably be positioned in the lower cable trays.

The cables given in Table 1 shall be used for the tests.

Table 1 — Cable fire load

Tray	Cable type	Diameter mm	CU number	Number of cables	Total length [a] m
1	NYY-O 2 × 1,5	12	29	35	525
2	NYY-O 2 × 1,5	12	29	30	450
	J-Y(St)Y 12 × 2 × 0,8	14	123	10	150
3	J-Y(St)Y 12 × 2 × 0,8	14	123	20	300
	NYY-J 4 × 10	20	384	20	300
4	J-Y(St)Y 12 × 2 × 0,8	14	123	20	300
	NYY-J 4 × 10	20	384	10	150
5	NYY-J 4 × 10	20	384	30	450
6	NYY-J 3 × 50/25	31	1680	15	225
7	NYY-J 3 × 50/25	31	1680	3	45
	NYY-J 4 × 120	42	4608	5	75
8	NYY-J 4 × 120	42	4608	5	75

[a] Cable length may be reduced if the fire does not extend to the cable ends during the tests.

5.5 Conditioning of fire load

The fuel package elements shall have a normal humidity content prior to the test, as obtained by storage indoor at (20 ± 5) °C for two weeks.

5.6 Ignition source

As fire source a propane gas burner with (250 ± 25) kW shall be centrally placed on the floor 2 500 mm from the end of the cable trays underneath the lowest cable tray 8 as per figure 1 and shall be constantly burning.

5.7 Ventilation conditions

All tests shall be carried out under a forced longitudinal ventilation along the cable tunnel enclosure of at least (1 ± 0,2) m/s.

The ventilation shall be adjusted to the chosen value before the fire tests start and shall be kept constant during the performance of the fire test.

Performing the tests under higher air velocities is up to the manufacturer.

6 Test arrangement

The maximum nozzle ceiling height and spacing (as specified by the manufacturer) shall be used for all tests.

Nozzle and piping arrangement is up to the manufacturer and shall meet the following requirements:

a) A minimum of eight cable trays above each other shall be used. The maximum number of cable trays above each other protected per nozzle line shall be specified in the manufacturer's DIOM manual.

b) If a single line of nozzles protects cable trays on both sides of the enclosure, it is sufficient to lay cable fire load only on cable trays on one side of the enclosure during testing. On the other side, plastic (e.g. PE, PP) cable insulation material shall be provided on empty trays to prove that the fire does not spread from the source side to the target side.

The nozzles shall be installed in a way that the gas burner is placed in the centre between two adjacent nozzles.

Tests shall be carried out with the minimum and maximum distances between the nozzle and the cable tray.

7 Test equipment requirements

7.1 For all fire tests, the ceiling, floor, and walls shall be as dry as possible, with only the permissibly moisture content of the environment. The relative humidity in the test enclosure shall not significantly differ from that of the ambient relative humidity of the environment.

7.2 The test enclosures shall be at an ambient temperature of (20 ± 10) °C prior to the start of the test. The enclosure shall be at as uniform ambient temperature as reasonably possible. Localized hot or cold spots are not permitted.

7.3 The minimum operating nozzle pressure (as specified by the manufacturer) shall be used for all tests, unless otherwise noted. System operating pressures shall be repeatable with a tolerance of ± 5 %.

7.4 The maximum spacing as specified by the manufacturer shall be used for all tests.

7.5 Maximum allowed time delay of water pressure build-up of the system shall be specified by the manufacturer and shall be used for all tests.

8 Instrumentation requirements

8.1 General

The following measurements shall be recorded with a tolerance of a ± 5 % at intervals not exceeding 1 s by using a computerized data acquisition system. Measurements shall begin and end at least 1 min prior to ignition and after termination of the tests.

All measured values shall be recorded over the entire test period. The tests shall also be recorded per video. Any damage of the test assembly shall be photographed and specified in the test report after each test.

8.2 Temperature

T [°C]: For measuring the temperature, exposed max. 1 mm thermocouples of type K shall be used.

The positions of the thermocouples shall be in accordance with Figure 1.

— T_1 to T_7 [°C] – centrally 150 mm below the ceiling surface in longitudinal direction of the cable tunnel and uniformly distributed;

— T_8 to T_{14} [°C] – between trays 1 and 2, centrally in longitudinal direction of the cable tunnel and uniformly distributed;

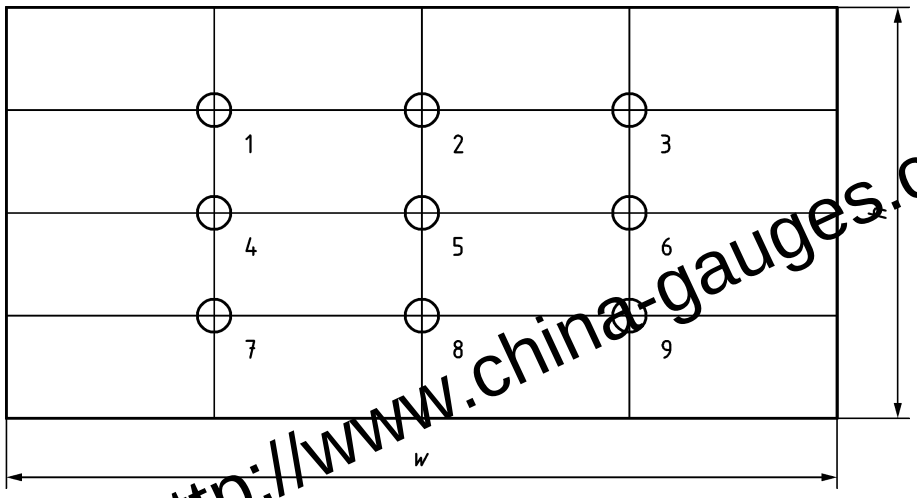
— T_{15} [°C] – within the plume of the initiating gas burner.

The temperature values measured during the test shall be averaged over 30 s (maximum time between measurements 1 s), and the peak temperatures shall be determined from the averaged curves.

Direct impingement on the thermocouples shall be avoided by means of appropriate protection hoods.

8.3 Air velocity

v [m/s]: The air velocity along the cable tunnel shall be measured in the section of the free space of the walkway 2 000 mm in front and 2 000 mm after the ignition source by suitable equipment (a pitot tube or a vane/hot wire anemometer). The measurements shall be determined by dividing the cross section of the duct into 16 equal subsections. Air velocity shall be measured from the intersection of the boundaries of each section, equalling to a minimum of nine measuring points (see Figure 2), and the obtained values shall be averaged to determine the velocity along the cable tunnel. An alternative means for measuring velocity may be used when judged to provide equivalent results.



Key

h height

w width

◯ measuring point

Figure 2 — Air velocity measurement points inside the cable tunnel

8.4 Pressure

p [bar]: The pressure shall be measured at ceiling height at the hydraulically most remote position of the pipe network.

8.5 Time

t [mm:ss]: Time measurement over the entire test period, with the following times being recorded:

— start of data recording;

— ignition;

— activation of water mist system;

— extinguishment of flames (if applicable);

— shut off of water mist systems;

— end of data recording.

9 Test criteria

9.1 General

The test protocol covers deluge water mist systems with open nozzles which are either activated with an automatic release system, e.g. fire detection system, or manually released.

For both the automatic and the manual release system the 250 kW propane gas burner shall be placed on the floor centrally underneath the cable trays and shall be constantly burning for 5 min. After these 5 min, the gas burner shall be switched off.

Temperatures measured and recorded during the fire tests shall be averaged over 30 s with 1 s sampling interval.

9.2 Carrying out the test with automatic release system

For automatic release systems the water mist system shall be released 5 min after ignition of the gas burner (5 min pre-burn time).

A repetition test shall be conducted.

9.3 Carrying out the test without automatic release system (manual release system)

For manual release systems, the water mist system shall be released after a minimum of 10 min after ignition of the gas burner (minimum 10 min pre-burn time).

A repetition test shall be conducted.

9.4 Pass/fail criteria

The fire tests have been successfully passed, when the following applies.

a) All temperatures in the fire tests enclosure shall be below 100 °C within 5 min from the start of the water mist discharge.

b) After switching off the water mist spray no more than small localized flamelets on a single tray or embers shall be visible at any of the cables. No re-ignition shall occur over a period of 15 min after switching off the water mist spray.

c) After the fire test, at least 500 mm of all cables on each cable tray shall not be damaged by the fire at both ends.

10 Test report

The results of the tests shall be documented in a test report prepared in accordance with EN 14972-1:2020, A.8.

National Annex NA
(Informative)

Further recommendations and guidance on the application of BS EN 14972-11

NA.1 General

This National Annex contains further recommendations that the UK committee believes would be beneficial in the application of all water mist systems alongside the requirements of BS EN 14972-1.

NA.2 Hazard evaluation

Users are encouraged carry out a hazard evaluation on any proposed application of BS EN 14972-11 to ensure that the fire test protocol and performance objectives match the occupancy and protection requirements at all times.

Guidance on the methodology for the hazard evaluation can be found in BS EN 14972-1:2020, 4.1.3.2 and 4.7.3 and BS 5306-0:2020, Clause 4.

NA.3 Limits of application

FM5560 refers to FM Global Data Sheets that define the limits of application which is not currently defined in BS EN 14972-1. Users are encouraged to adhere to any applicable FM Global Property Loss Prevention Data Sheet.

NA.4 Ventilation conditions

It is encouraged that ventilation conditions in the application be within the limits of the ventilation as simulated in the fire test protocol. Thus, where ventilation effects do not feature in the test protocol, application should be unventilated.

Occupancies with forced or natural air flow might require additional fire testing to achieve the same performance criteria or alternatively a means, where permissible, to shut down the ventilation.

NA.5 Obstructions

Fire tests are undertaken with limited obstructions. Example of types of obstruction that are not included in the fire test:

- cable trays;
- light fittings;
- ducts;
- architectural features;
- beams; and
- columns.

Further testing is recommended to derive installation obstruction rule sets.

It would be beneficial for the designer to consider (and mitigate) the presence of obstructions (e.g. with additional testing and/or additional nozzles).

NOTE Obstructions impede the distribution of water mist and could prevent the system from achieving the fire suppression objectives as defined in the fire test protocol.

NA.6 Test report

Users' results of the tests may be documented in a test report prepared in accordance with BS EN ISO/IEC 17025:2017, 7.8 and BS EN 14972-1. A succinct test report might contain at least the following information:

a) a title;

b) the name and address of the laboratory;

c) the location where the tests were carried out, if different from the address of the laboratory;

d) unique identification of the test report (such as the serial number), and on each page an identification in order to ensure that the page is recognized as a part of the test report, and a clear identification of the end of the test report;

e) the name and address of the client;

f) a description of the method used, including details of the test apparatus and a reference to the standard against which the system was tested (e.g. BS EN 14972-10);

g) a description of, the condition of, and unambiguous identification of the item(s) tested;

h) the date of receipt of the test item(s) where this is critical to the validity and application of the results, and the date(s) of performance of the test;

i) the test results, with units of measurement where appropriate, together with the times and parameters recorded during each test;

j) a statement of compliance/non-compliance with the recommendations given in all applicable assessment criteria clauses;

k) confirmation of system design parameters relevant to the specific application, including, but not limited to, the following:

   1) the discharge duration;

   2) nozzle designation;

   3) room dimensions and nozzle positions (this should be in written form and also shown on a plan view drawing);

   4) test room height;

   5) operating flow rate to the nozzle(s);

   6) distance between the ceiling and nozzle orifice;

   7) pressure over the duration of the test;

   8) type of detection/actuation method;

   9) additives, propellants and atomizing media used;

   10) details of the test hall geometry;

   11) ventilation conditions during the test, supported by engineering calculations pertinent to the actual application and the effect of the fire plume on ventilation; and

   12) environmental conditions during the test;

l) the name(s), function(s) and signature(s) or equivalent identification of person(s) authorizing the test report; and

m) where relevant, a statement to the effect that the results relate only to the items tested.

NATIONAL ANNEX NB
(Informative)

WATER MIST COMPONENT
MANUFACTURER'S DECLARATION OF CONFORMITY (MDOC) For manufacturer supplied nozzles and fire testing results

Address of manufacturer

……

……

Component: (including description, model, unique identifier)

Nozzle tested: ……

Other component (integral to test): ……

Declaration of Conformity

I/we* hereby declare that the water mist nozzles and components detailed above conform, to the best of my/our* knowledge and belief, to the appropriate recommendations given in BS EN 14972-11:2023, BS EN 14972-1:2020, and BS 8663-1, except as stated below/overleaf.

* Delete as appropriate

Signed, on behalf of manufacturer (as appropriate)

……

Name (print):…….. Company name: ……

Job title/qualification…… Date……

Deviations from standards

Declaration	**BS EN 14972-11; BS EN 14972-1; or BS 8663-1 clause number**	**Details of deviation**

This document is only valid when accompanied by current documents:

Type	**Title, issue, date**	**For official use**	
		Received	**Notes**
Manufacturer's component data sheet			
Manufacturer's component data drawings (on request)			
Manufacturer's system design manual and installation manual			
Manufacturer's MDOC Table 1			
Manufacturer's MDOC Table 2			

Table NB.1 – MDOC Table 1 – Declaration of nozzle details and system design parameters

Parameter	Nozzle specification and limits	Details to be completed by manufacturer	For official use Notes
Nozzle	Manufacturer		
	Nozzle designation (model, unique identifier)		
	Datasheet (name, issue, date)		
	Type (upright/pendent/concealed/sidewall)		
	K-factor (lpm/bar ½)		
	Nozzle orifice diameter (s)		
	Form of construction: • Nozzle body material • Pipework fitting requirements • Valve type		
	Strainer and filter requirements and minimum strainer area(s)		
	Water quality requirements (e.g. statement that potable water may be used, or specific limits in terms of total dissolved solids and/or ppm of dissolved substances, and levels of hardness, sulphates and chlorine and bacteria		
	Additives dependency, requirements to ensure enhance fire protection requirements (e.g. concentration and rates of application), if required		
	Product approval, certificate number and date (confirmation of compliance to BS 8663-1 or LPCB LPS 1283 scheme of requirements) Note: Compliance with these requirements includes: • Tests for nozzle function at min standby pressure • Tests for nozzle aging (heat exposure tested at 121°C for 90 days at max standby pressure), • Test for sulfur dioxide exposure of dynamic 'o' rings		
Flow	Supply type (pump or cylinder) Note: If the system relies upon propellant gas cylinder(s), full details shall be provided.		
	Minimum operating pressure (bar) and flow rate (l/min)		
	Maximum operating pressure (bar) and flow rate (l/min)		
	Standby pressure, minimum (bar)		
	Standby pressure, maximum (bar)		
	Operating pressure, min (bar) and flowrate min (l/min)		
	Operating pressure, max (bar) and flowrate max (l/min)		
Installation	Maximum nozzle spacing (m)		
	Minimum nozzle spacing (m)		
	Maximum depth below ceiling (mm)		

	Maximum room area (m^2)		
	Maximum ceiling height (m)		
	Minimum ceiling height (m)		
Dimensioning of water supply	Minimum design area (m^2)		
	Minimum number of nozzles		
	Minimum design duration (min)		
	Flat ceilings and limited slopes		
	Deviations from standard/extensions to scope	**Details and additional supporting information**	
	Obstructions		
	Other		

Table NB.2 – MDOC Table 2 – Declaration of conformance to BS EN 14972-6 fire test protocol for the nozzle in MDOC Table 1

Information required	Details to be completed by manufacturer	For official use
Fire Test Report (report number, number of pages, date, issue number)		
Name and address of test laboratory (independent third-party with appropriately skills and accreditation)		
Nozzle arrangement (model, material, unique identifier), type, orientation, k-factor, temperature rating, spacing, operating pressure		
Details of any additives used in the test programme		
Details of the water supply method used in the test programme (pump/cylinder specification as well as pressure/flow and duration)		
Fire test series arrangements completed (as defined in BS EN 14972-11:2023)		
Any other supporting data		
Questions	**Answer (yes/no)** **If no, detail non-compliances and provide supporting data**	
Is the test report by an independent third-party, UKAS accredited test laboratory or equivalent?		
Is the nozzle in MDOC Table 1 identical to that used for all fire tests?		
Is the nozzle arrangement (e.g. spacing, pressure, flow, height depth) in MDOC Table 1 identical to that used for all fire tests?		
Is the maximum atrium area in MDOC Table 1 confirmed by successful completion of all tests and against all clauses of BS EN 14972-11:2023 and National Annexes?		
Is the maximum atrium height in MDOC Table 1 confirmed by successful completion of all tests and against all clauses of BS EN 14972-11:2023 and National Annexes?		
Does the water mist system and test report show full compliance with all of the clauses of BS EN 14972-11:2023 and National Annexes?		

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