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Fixed fire protection systems – Industrial and commercial watermist systems

Part 4: Fire performance tests and requirements for watermist systems for local applications involving flammable liquid fires

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 24, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 8489 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 May 2016. It was prepared by Subcommittee FSH/18/5, *Watermist systems*, under the authority of Technical Committee FSH/18, *Fixed fire fighting systems*. A list of organizations represented on these committees can be obtained on request to their secretary.

Supersession

This part of BS 8489 supersedes DD 8489-4:2011, which is withdrawn.

Relationship with other publications

BS 8489 is published in a series of parts:

- Part 1: *Code of practice for design and installation*;
- Part 4: *Tests and requirements for watermist systems for local applications involving flammable liquid fires*;
- Part 5: *Tests and requirements for watermist systems for the protection of combustion turbines and machinery spaces with volumes up to and including 80 m^3*;
- Part 6: *Tests and requirements for watermist systems for the protection of industrial oil cookers*;
- Part 7: *Tests and requirements for watermist systems for the protection of low hazard occupancies*.

BS 8489-4 is intended to be read in conjunction with BS 8489-1.

Information about this document

This document converts DD 8489-4 into a full British Standard.

Third-party testing/certification. Users of this British Standard are advised to consider the desirability of third-party testing/certification of conformity with this British Standard.

Use of this document

This British Standard is intended for use by manufacturers, designers and installers of watermist systems, and for authorities having jurisdiction.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its methods are expressed as a set of instructions, a description, or in sentences in which the principal auxiliary verb is "shall". Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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1 Scope

This part of BS 8489 describes tests and specifies requirements for industrial and commercial watermist systems for local applications involving flammable liquid fires.

The tests specified in this part of BS 8489 are applicable to the following applications:

a) flammable liquid pool fires where the liquid release can be confined to a bunded area, where the entire surface of the bunded area is protected by the watermist system;

b) flammable liquid channel fires in channels not exceeding the watermist system manufacturer's maximum specified width and with no limit to channel length;

c) partially obstructed flammable liquid pool fires where the percentage of obstructed surface is limited to that tested;

d) spray fires up to 6 MW fuelled by flammable liquids;

e) spray and pool fire combinations where confined to a bunded area;

f) flammable liquid residues (ink and paper dust) on printing presses.

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.

BS 8489-1, *Fixed fire protection systems – Industrial and commercial watermist systems – Part 1: Code of practice for design and installation*

BS EN ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*

3 Terms and definitions

For the purposes of this part of BS 8489, the terms and definitions given in BS 8489-1 apply.

4 Principle

The local application fire performance tests involving flammable liquids comprise: open, obstructed and offset pool fires; spray fires; and combined pool and spray fires, utilizing both heptane and diesel fuels. The watermist system needs to pass all tests.

5 Square pool fire

5.1 Test

5.1.1 Apparatus

NOTE Unless otherwise stated, the following tolerances apply:

- *length: ±2%;*
- *volume: ±5%;*

- *pressure: ±3%;*
- *temperature: ±5%*.

5.1.1.1 *Test hall*, greater than 500 m^3 in area with a minimum ceiling height of 5 m. Ventilation during testing, between tests, and for cooling of the enclosure, shall be provided by a minimum of two 0.93 m^2 louvre vents located on the roof of test hall and a side wall doorway measuring at least (3.66 × 4.26) m, to be left partially open during fire testing for a minimum area of (3.66 × 1.82) m. The vents shall be protected by baffles if necessary to remove the effects of external winds/air movements.

5.1.1.2 *Watermist system*, comprising nozzles, piping, control valves and water supplies, configured in accordance with the manufacturer's design manual and with the test conditions specified in **5.1.2**.

5.1.1.3 *Three test pools*, of sizes 1 m × 1 m, 2 m × 2 m and 3 m × 3 m, each comprising a square pan or tray, of steel construction, 1.73 mm thick and 100 mm high with no lip, with smooth surfaces and edges that are free from imperfections, containing a water base of 50 mm in height, with a fuel load of at least 20 mm above the water. The pools shall be configured as shown in Figure 1. For hazards with diesel fuels, the pools shall contain diesel. Where it is intended to use flammable liquids with volatilities greater than those of diesel, but not greater than those of heptane, then the tests shall be conducted using heptane. After each pool fire test, the fuel left in the pool or tray shall be reignited to ensure that sufficient fuel remains in the pan.

5.1.1.4 *Thermocouples*, which shall be located (25 ±2) mm above the initial pool surface and (250 ±10) mm within the pool rim, capable of registering extinguishment.

NOTE In addition to thermocouples, thermal imaging equipment is recommended.

5.1.1.5 *Instrumentation* to measure and record the following parameters:

a) temperature of fuel in pools;

b) pool fire flame temperatures;

c) test enclosure temperatures;

d) extinguishing agent flow and pressure in the extinguishing system;

e) water supply pressure (including tank pressure if applicable) and nozzle discharge pressures;

f) extinguishing agent pressure at the most remote nozzle branch line;

g) gas pressure at its storage outlet and distribution sources;

h) oxygen, carbon monoxide, and carbon dioxide concentrations;

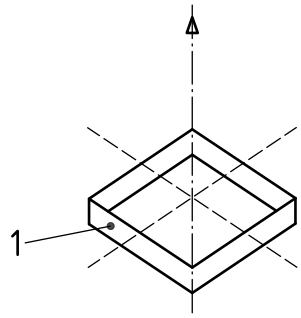
i) consumption of foam concentrate or other additive, recorded by means of a load cell on which the concentrate/additive tank is placed during the tests;

j) gas consumption (gas used to drive water from cylinders supplying the watermist system), measured by means of pressure or load cell on which the gas tank is placed during the tests, or mass flow measurement.

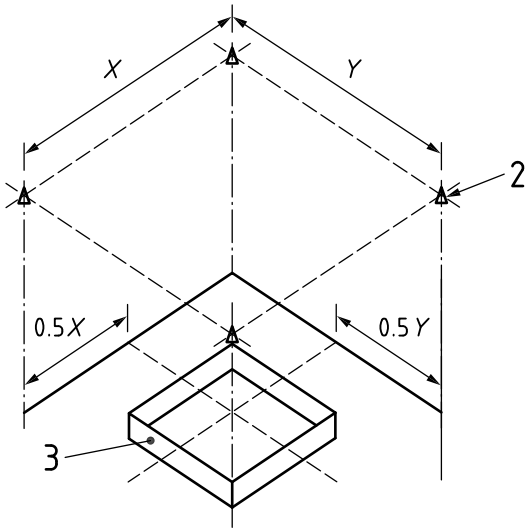
5.1.1.6 *Additional baffles or obstructions*, if needed, to prevent the direct impact of mist on the pool fire.

5.1.1.7 *Stopwatch*.

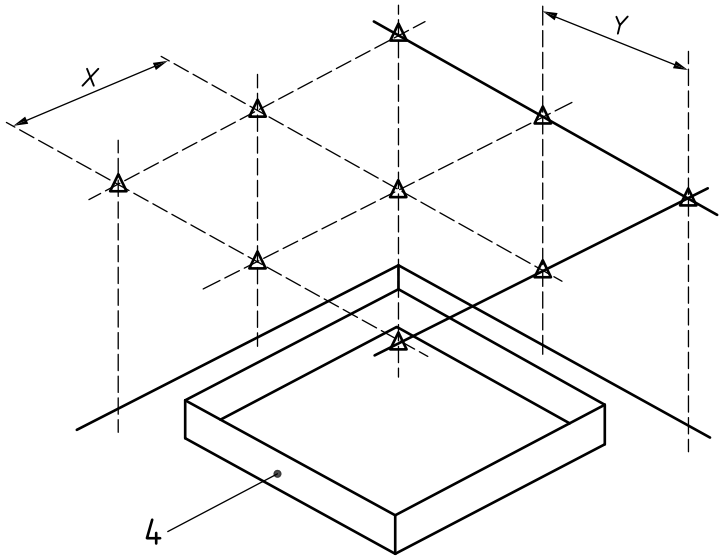
Figure 1 **Configuration for square diesel pool**



a) 1 m² pool fire



b) 4 m² pool fires



c) 9 m² pool fire

Key

1 Pan, 1 m²
2 Nozzle
3 Pan, 4 m²
4 Pan, 9 m²
X Manufacturer's maximum longitudinal nozzle spacing
Y Manufacturer's maximum latitudinal nozzle spacing

5.1.2 Test conditions

5.1.2.1 The minimum operating nozzle pressure (as specified by the manufacturer) shall be used for all tests. System operating pressures shall be maintained to within ±5%. For decaying pressure systems, the starting pressure shall be within ±5% of the manufacturer's designated starting pressure.
For systems designed to cycle between two pressure limits, both the higher and lower pressures shall be within ±5% of the manufacturer's designated pressures, and the periods pertaining to the higher and lower pressure in each cycle shall be within ±3 s of the manufacturer's designated duration.

5.1.2.2 The maximum ceiling height, maximum nozzle height and maximum nozzle spacing (as specified by the manufacturer) shall be used for all tests. This includes utilizing the maximum ceiling spacing of nozzles from walls.

5.1.2.3 The nozzle arrangement shall have uniform spacing. The nozzle spacing from the wall shall be uniform.

NOTE The nozzle spacing from the wall should preferably be one half the main spacing.

5.1.2.4 For all fire tests, the ceiling, floor and walls shall be dry. The relative humidity in the test enclosure prior to the start of the test shall not differ from that of the ambient relative humidity by more than 20%.

5.1.2.5 All fuels shall be at an ambient temperature of (20 ±10) °C, measured with the thermocouple located in the approximate centre of the initial fuel layer.

5.1.2.6 The test hall shall have an ambient temperature of (20 ±10) °C prior to the start of the test, measured in the central area of the test hall at one-third, two-thirds and ceiling heights. The test hall shall be at as uniform an ambient temperature as is reasonably practicable, with no localized hot or cold spots. All non-fire-induced draughts shall be eliminated.

5.1.2.7 The extinguishing agent flow and pressure in the extinguishing system shall be measured continuously on the high pressure side of the pump, cylinder or equivalent equipment.

5.1.2.8 The water supply and nozzle discharge pressures shall be monitored at the source (pump and/or cylinder) and at the distribution piping manifold.

5.1.2.9 Test rig temperatures shall be measured away from the direct flame impingement with bare bead thermocouples welded from 28 gauge Chromel-alumel wire (Type K).

5.1.2.10 Oxygen shall be measured 2 m to 3 m from, and at the elevation of, the rim of the pool fires, and away from any open doorways or ventilation sources. Ventilation rates shall be monitored and recorded if constantly provided for the enclosure.

5.1.2.11 The ratio of total number of nozzles in the grid versus the pool area shall remain constant (i.e. two nozzles for 1 m^2 pool, four nozzles for 2 m^2 pool, eight nozzles for 4 m^2 pool).

5.1.2.12 The nozzle grid elevation above the pool shall remain constant for all pool sizes.

5.1.2.13 Where nozzle protection caps are used to prevent or reduce the amount of nozzle contamination, the use of such caps shall be included in the test.

5.1.3 Procedure

5.1.3.1 The test shall be conducted with the nozzles in each of the following positions (four tests in total):

a) 1 m × 1 m pool: maximum height;

b) 2 m × 2 m pool: maximum height;

c) 3 m × 3 m pool: maximum height;

d) 3 m × 3 m pool: minimum height.

5.1.3.2 The test shall be conducted for 30 min or until the fire is extinguished or the length of time to discharge 50% of the water agent, whichever is shorter.

NOTE There is no minimum extinguishing agent discharge time.

5.1.3.3 System components, component locations, operating conditions and test enclosure details shall remain unaltered throughout all of the fire tests for a given application. During each test, all systems shall operate without manual intervention. All tests shall be conducted using the specifications from the manufacturer's design and installation manual with regard to nozzle placement, spray flux, and spray duration. For intermittent sprays, the time between the consecutive spray shots shall be not less than 50% of the total time, as related to a specific watermist system.

NOTE Sprays may be continuous or intermittent in time, at the manufacturer's discretion.

5.1.3.4 Following ignition of a pool fire, a pre-burn time shall be allowed before activation of the watermist system. The pre-burn time shall commence when the flames have spread across the entire pool. Fire pre-burn times shall be as follows:

a) heptane pool fires: 15 s;

b) diesel pool fires: 30 s.

5.1.3.5 The fire shall be deemed to be extinguished when the temperature registration drops below 100 °C and does not increase. Following extinguishment, the fuel left in the pool or tray shall be reignited. If reignition is not achieved, the test shall be deemed to be inconclusive and shall be repeated with new fuel.

5.1.3.6 The following times shall be recorded during testing:

a) start of ignition procedure;

b) start of test fuel ignition;

c) time when the extinguishing system is activated with watermist discharging from the nozzles;

d) time when the fire(s) is extinguished;

NOTE Use of a thermal imaging camera is recommended.

e) time when the extinguishing system is shut off;

f) time of reignition (if any);

g) time when the test is finished.

5.1.3.7 The following parameters shall be recorded during testing:

a) temperature of fuel in the pool;

b) temperature of flame;

c) temperature of test enclosure;

d) extinguishing agent flow and pressure in the extinguishing system;

e) water supply pressure (including tank pressure if applicable) and nozzle discharge pressure;

f) extinguishing agent pressure at the most remote nozzle branch line;

g) gas pressure at its storage outlet and distribution sources;

h) oxygen, carbon monoxide, and carbon dioxide concentrations;

i) consumption of foam concentrate or other additive;

j) gas consumption (gas used to drive water from cylinders supplying the watermist system).

5.1.3.8 Each test shall be repeated, and the results of both sets of tests (eight in total) shall then be documented in a test report prepared in accordance with BS EN ISO/IEC 17025:2005, **5.10**. The test report shall contain at least the following information:

a) a title;

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

c) unique identification of the test report (such as the serial number), an identification on each page 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;

d) the name and address of the client;

e) a description of the method used, including details of the test apparatus and a reference to the standard against which the system was tested, i.e. BS 8489-4;

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

g) 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;

h) reference to the sampling plan and procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results;

i) the test results, with units of measurement where appropriate, including the percentage of any damage to the system components, test rig, or test enclosure, together with the times recorded in **5.1.3.6** and the parameters recorded in **5.1.3.7**;

j) a statement of compliance/non-compliance with the pass/fail criteria specified in **5.2**;

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

   1) the extinguishing time, system duration and discharge duration;

   2) nozzle designation;

   3) permitted location in the protected volume;

   4) minimum and maximum installation height limitation;

   5) maximum dimensional and area coverage, including spacing between the nozzles;

6) operating flow rates of the nozzle;
7) distance between the ceiling and nozzle orifice;
8) maximum and minimum design pressure over the duration of the test;
9) type of detection/actuation method;
10) additives, propellants and atomizing media used;
11) details of the test hall geometry;
12) ventilation conditions during the test;
13) environmental conditions during the test;

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

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

5.2 Pass/fail criteria

When tested in accordance with **5.1**, the watermist system shall be deemed to have passed the test if:

a) the fire is extinguished; and

b) the extinguishment time for each of the eight tests is within ±30% of the mean time for all the tests.

6 Channel diesel pool fire

6.1 Test

6.1.1 Apparatus

*NOTE See the Note to **5.1.1** for tolerances.*

6.1.1.1 *Test hall*, as specified in **5.1.1.1**.

6.1.1.2 *Watermist system*, as specified in **5.1.1.2**.

6.1.1.3 *Three test pools*, constructed in accordance with **5.1.1.3**, of sizes $Y \times Y$, $Y \times 2Y$ and $Y \times 3Y$, where Y is the watermist system manufacturer's specified maximum channel width, and configured as shown in Figure 2.

6.1.1.4 *Thermocouples*, as specified in **5.1.1.4**.

6.1.1.5 *Instrumentation*, to measure and record the parameters given in **5.1.1.5**.

6.1.1.6 *Additional baffles or obstructions*, if needed, to prevent the direct impact of mist on the pool fire.

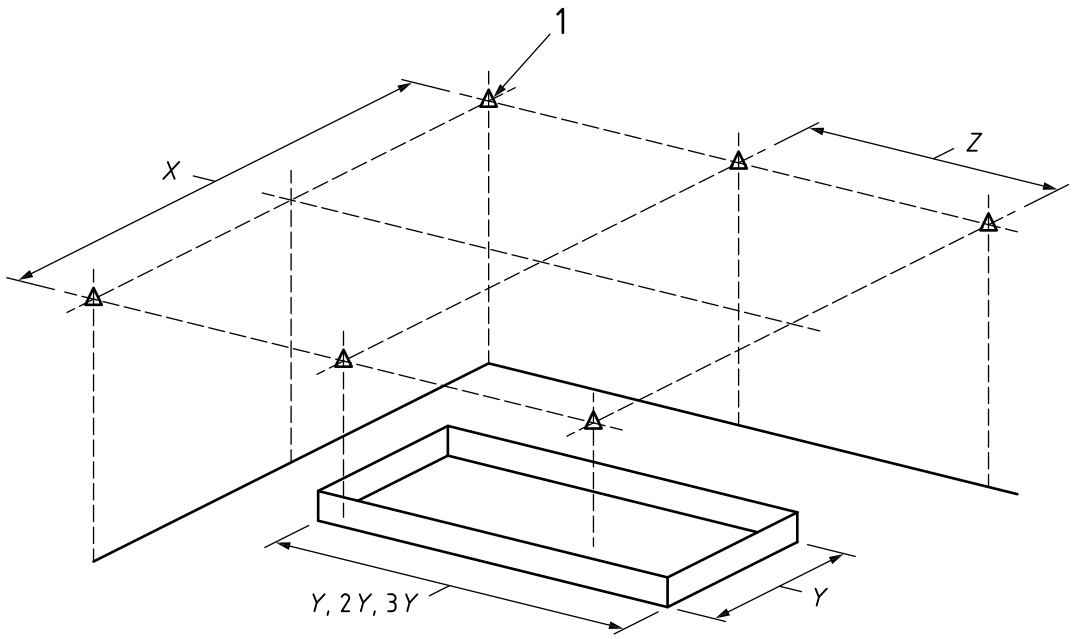
6.1.1.7 *Stopwatch*.

6.1.2 Test conditions

6.1.2.1 The test conditions shall be in accordance with **5.1.2** and the following.

6.1.2.2 The nozzles shall be located along the two opposite sides of the channel.

Figure 2 **Configuration for channel diesel pool**



Key

1 Nozzle

X Manufacturer's maximum latitudinal nozzle spacing, if different from Z

Y Manufacturer's specified maximum channel width

Z Manufacturer's maximum specified spacing

6.1.3 Procedure

6.1.3.1 The test shall be conducted with the nozzles in each of the following positions (four tests in total):

a) *Y* by *Y* channel: maximum height;

b) *Y* by 2*Y* channel: maximum height;

c) *Y* by 3*Y* channel: maximum height;

d) *Y* by 3*Y* channel: minimum height.

6.1.3.2 The procedures specified in **5.1.3.2** to **5.1.3.7** shall be followed.

6.1.3.3 Each test shall be repeated, and the results of both sets of tests (eight in total) shall then be documented in a test report as specified in **5.1.3.8**, except that the statement of compliance/non-compliance specified in **5.1.3.8**j) shall refer to the pass/fail criteria in **6.2**.

6.2 Pass/fail criteria

When tested in accordance with **6.1**, the watermist system shall be deemed to have passed the test if:

a) the fires are extinguished; and

b) the extinguishment time for each of the eight tests is within ±30% of the mean time for all the tests.

7 Heptane spray fire

7.1 Test

7.1.1 Apparatus

*NOTE See the Note to **5.1.1** for tolerances.*

7.1.1.1 *Test hall*, as specified in **5.1.1.1**.

7.1.1.2 *Watermist system*, as specified in **5.1.1.2**.

7.1.1.3 *Conventional oil burner*, with the characteristics for a single 5.8 MW spray fire, as specified in Table 1.

Table 1 **Characteristics of oil burners for tests involving spray fires**

Fire type	Spray nozzle [A]	Fuel type	Nominal oil pressure	Fuel flow	Fuel temp.	Nominal heat release rate
			bar [B]	kg/s	°C	MW
Low pressure	Lechler model 460.728	Light diesel	8.2	0.16 ±0.01	20 ±10	5.8 ±0.6
		Heptane	8.2	0.14 ±0.01	20 ±10	5.8 ±0.6

[A] Lechler 460.728 is a trade mark owned by Lechler GmbH, Ulmer Straße 128, 72555 Metzingen, Germany. This is a trade name of a product available in the UK. This information is given for the convenience of users of this part of BS 8489 and does not constitute an endorsement by BSI of the product named. Equivalent products may be used if they can be shown to lead to the same results.

[B] 1 bar = 10^5 N/m^2 = 100 kPa.

7.1.1.4 *Fixture stand*, which shall be a free-standing secure arrangement, constructed of metal, with the oil burner nozzle mounted within and centred at the closed end of a metal cylindrical flame stabilizer measuring 150 mm diameter × 75 mm with a thickness of 0.25 mm.

7.1.1.5 *Thermocouples*, which shall be located in front of the spray fires, capable of registering extinguishment.

NOTE In addition to thermocouples, thermal imaging equipment is recommended.

7.1.1.6 *Instrumentation* to measure and record the parameters given in **5.1.1.5**c) to **5.1.1.5**j) and the following:

a) temperature of air in spray fires;

b) spray fire temperatures;

c) fuel pressure and flow at the outlet of the fuel pump;

d) fuel temperature within the fuel storage container.

7.1.1.7 *Additional baffles or obstructions*, if needed, to prevent the direct impact of mist on the spray fire.

7.1.1.8 *Stopwatch*.

7.1.2 Test conditions

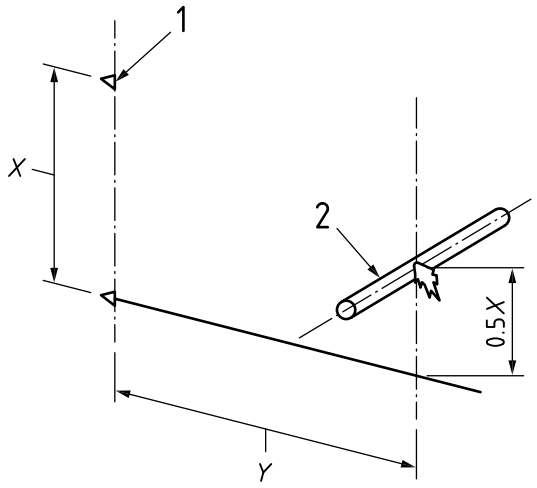
7.1.2.1 The test conditions shall be in accordance with **5.1.2.1** to **5.1.2.8** and the following.

7.1.2.2 Test rig temperatures shall be measured away from the direct flame impingement, (500 ±25) mm horizontally behind the fuel spray nozzle, with bare bead thermocouples welded from 28 gauge Chromel-alumel wire (Type K).

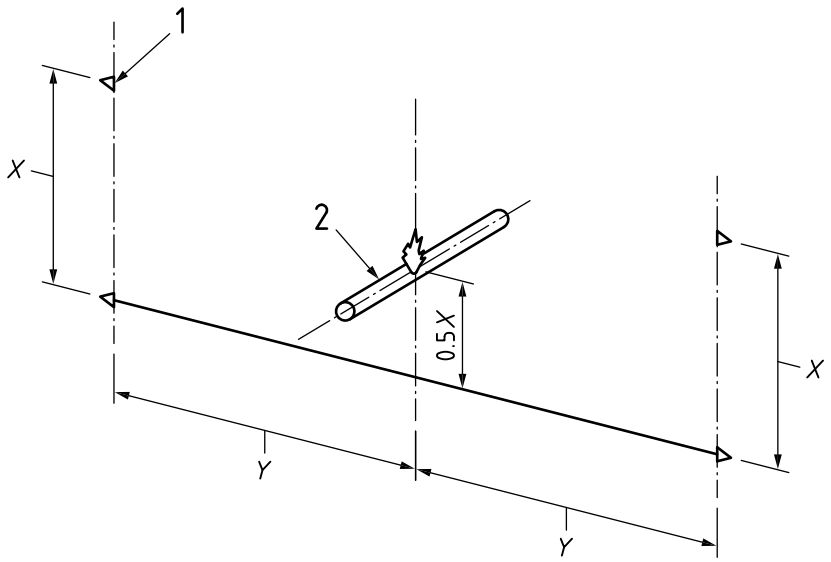
7.1.2.3 Oxygen shall be measured 100 mm behind and below the spray fire nozzle, and away from any open doorways or ventilation sources. Ventilation rates shall be monitored and recorded if constantly provided for the enclosure.

7.1.2.4 The tests shall be conducted with the heptane spray axis oriented horizontally and vertically as shown in Figure 3.

Figure 3 **Configuration for heptane spray fire**



a) Horizontal spray fire



b) Vertical spray fire

Key

1 Nozzle

2 Pipe, 150 mm diameter

X Manufacturer's maximum specified vertical spacing

Y Manufacturer's maximum specified horizontal spacing

7.1.3 Procedure

7.1.3.1 The test shall be conducted with the nozzles in each of the following positions (four tests in total):

a) horizontal spray: maximum height;

b) horizontal spray: minimum height;

c) vertical spray: maximum height;

d) vertical spray: minimum height.

7.1.3.2 Before commencing the test, the fuel pressure and flow at the outlet of the fuel pump shall be measured.

7.1.3.3 The test shall be conducted for 30 min or until the fire is extinguished or the length of time to discharge 50% of the water agent, whichever is shorter. The fuel spray shall be shut off 15 s after the fire extinguishment. The watermist discharge shall be shut off 45 s after the fuel spray is shut off.

NOTE There is no minimum extinguishing agent discharge time.

7.1.3.4 The system operation during the test shall be in accordance with **5.1.3.3**.

7.1.3.5 Following ignition of a spray fire, a pre-burn time of 15 s shall be allowed before activation of the watermist system. The pre-burn time shall commence upon ignition.

7.1.3.6 The fire shall be deemed to be extinguished when the temperature registration drops below 100 °C and does not increase.

7.1.3.7 The following times shall be recorded during testing:

a) the times specified in **5.1.3.6**;

b) time when the fuel is shut off.

7.1.3.8 The following parameters shall be recorded during testing:

a) the parameters specified in **5.1.3.7**b) to **5.1.3.7**j);

b) temperature of air;

c) spray fire temperatures;

d) fuel pressure and flow at the outlet of the fuel pump;

e) fuel temperature within the fuel storage container.

7.1.3.9 Each test shall be repeated, and the results of both sets of tests (eight in total) shall then be documented in a test report as specified in **5.1.3.8**, except that the statement of compliance/non-compliance specified in **5.1.3.8**j) shall refer to the pass/fail criteria in **7.2**.

7.2 Pass/fail criteria

When tested in accordance with **7.1**, the watermist system shall be deemed to have passed the test if the fires are extinguished during all eight tests.

8 Diesel pool fire, 2 m × 2 m square, combined with a 5.8 MW diesel spray fire

8.1 Test

8.1.1 Apparatus

*NOTE See the Note to **5.1.1** for tolerances.*

8.1.1.1 *Test hall*, as specified in **5.1.1.1**.

8.1.1.2 *Watermist system*, as specified in **5.1.1.2**.

8.1.1.3 *Test pool*, constructed in accordance with **5.1.1.3**, of size 2 m × 2 m.

8.1.1.4 *Conventional oil burner*, with the characteristics for a single 5.8 MW spray fire, as specified in **7.1.1.3**. The nozzle tip mounting arrangements above the pool surface shall be as follows:

a) pointed horizontally and centred 1 m above the pool (see Figure 4);

b) pointed 45° from horizontal and centred 1 m above the pool (see Figure 5);

c) pointed horizontally 1 m above the pool, and offset 0.5 m edgewise from the pool centre (see Figure 6);

d) pointed 45° from horizontal, 1 m above the pool, and offset 0.5 m edgewise from the pool centre (see Figure 7);

e) pointed horizontally, 0.3 m above the pool and offset 0.5 m edgewise from the pool centre (see Figure 8).

8.1.1.5 *Fixture stand*, as specified in **7.1.1.4**.

8.1.1.6 *Thermocouples*, as specified in **5.1.1.4** and **7.1.1.5**.

8.1.1.7 *Instrumentation*, as specified in **5.1.1.5** and **7.1.1.6**.

8.1.1.8 *Additional baffles or obstructions*, if needed, to prevent the direct impact of mist on the pool or spray fire.

8.1.1.9 *Stopwatch*.

8.1.2 Test conditions

The test conditions shall be in accordance with **5.1.2** and **7.1.2.2** to **7.1.2.4**.

8.1.3 Procedure

8.1.3.1 The test shall be conducted with the nozzles in each of the following positions (five tests in total):

a) mounting arrangement in **8.1.1.4**a): maximum height;

b) mounting arrangement in **8.1.1.4**b): maximum height;

c) mounting arrangement in **8.1.1.4**c): maximum height;

d) mounting arrangement in **8.1.1.4**d): maximum height;

e) mounting arrangement in **8.1.1.4**e): maximum height.

8.1.3.2 Before commencing the test, the fuel pressure and flow at the outlet of the fuel pump shall be measured.

8.1.3.3 The test shall be conducted for the length of time and with the shut-off times specified in **7.1.3.3**.

NOTE There is no minimum extinguishing agent discharge time.

8.1.3.4 The system operation during the test shall be in accordance with **7.1.3.3**.

8.1.3.5 The pool shall be ignited. The diesel spray above the pool surface shall then be initiated and ignited, 15 s after the flames have spread to the entire pool area. The watermist system shall be manually activated after a further 15 s.

8.1.3.6 The fire shall be deemed to be extinguished when the temperature registration drops below 100 °C and does not increase. Following extinguishment, the fuel left in the pool or tray shall be reignited. If reignition is not achieved, the test shall be deemed to be inconclusive and shall be repeated with new fuel.

8.1.3.7 The times specified in **7.1.3.7** shall be recorded during testing.

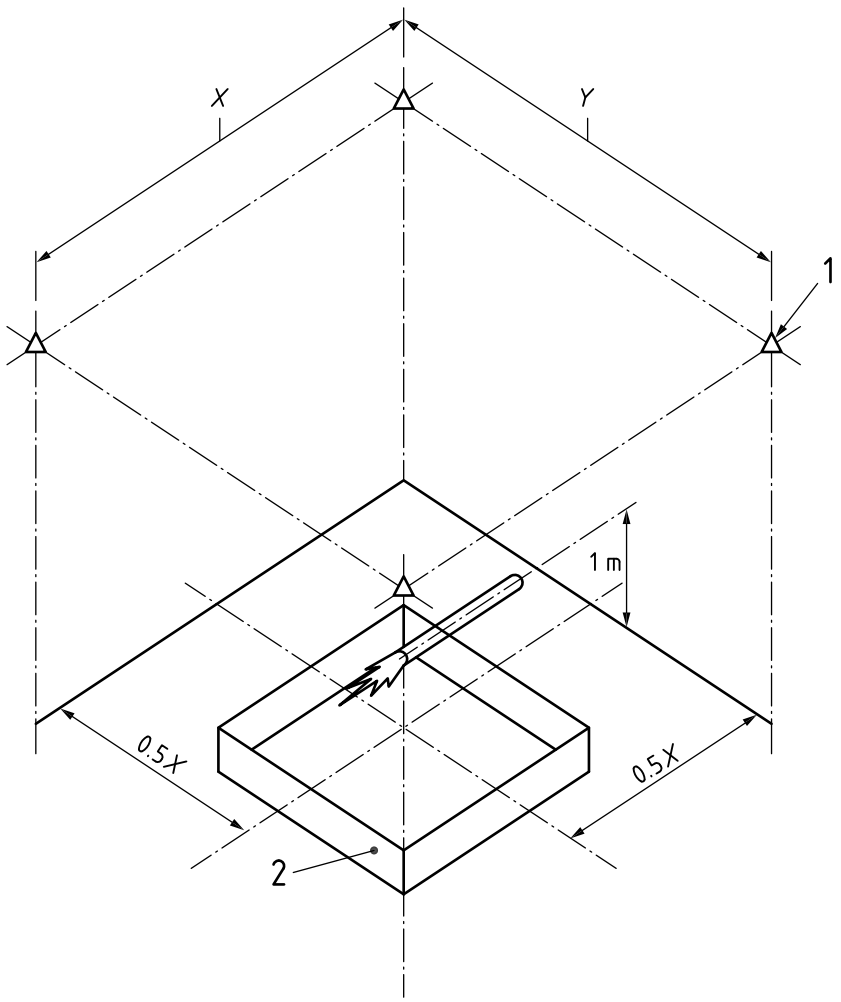
8.1.3.8 The parameters specified in **5.1.3.7** and **7.1.3.8** shall be recorded during testing.

8.1.3.9 Each test shall be repeated, and the results of both sets of tests (ten in total) shall then be documented in a test report as specified in **5.1.3.8**, except that the statement of compliance/non-compliance specified in **5.1.3.8**j) shall refer to the pass/fail criteria in **8.2**.

8.2 Pass/fail criteria

When tested in accordance with **8.1**, the watermist system shall be deemed to have passed the test if both the pool fires and the spray fires are extinguished during all ten tests.

Figure 4 **Configuration for pool/spray fire arrangements in 8.1.1.4a)**



Key

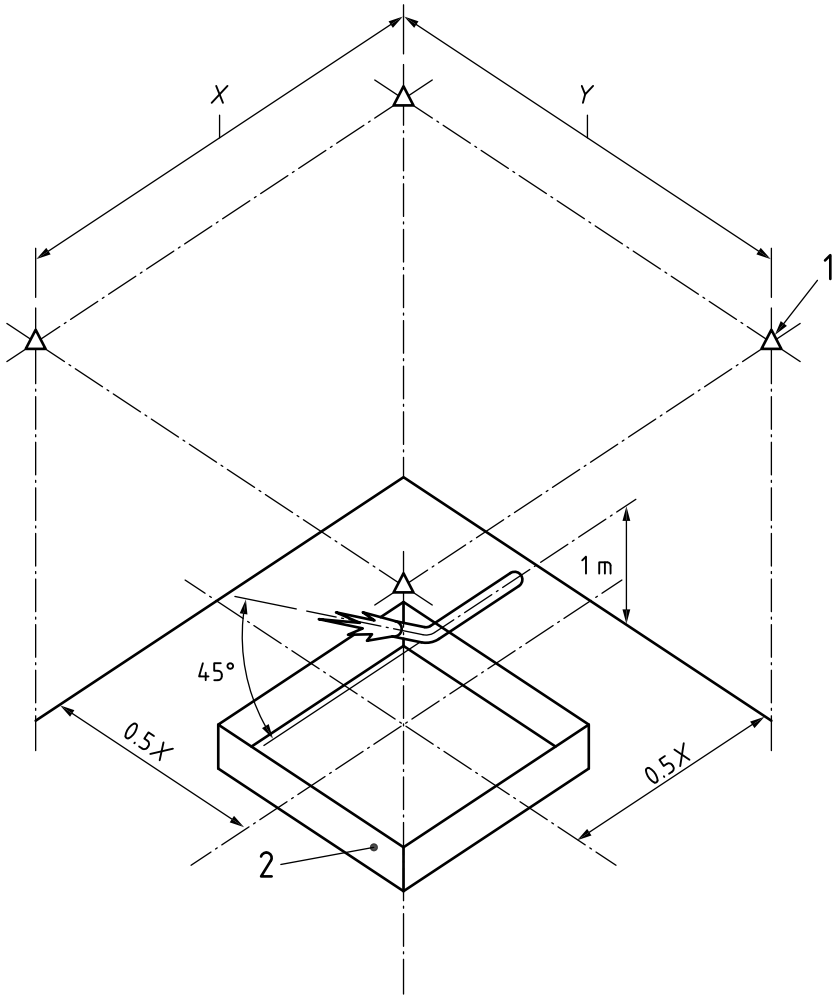
1 Nozzle

2 Pan, 4 m^2

X Manufacturer's maximum longitudinal nozzle spacing

Y Manufacturer's maximum latitudinal nozzle spacing

Figure 5 **Configuration for pool/spray fire arrangements in 8.1.1.4b)**



Key

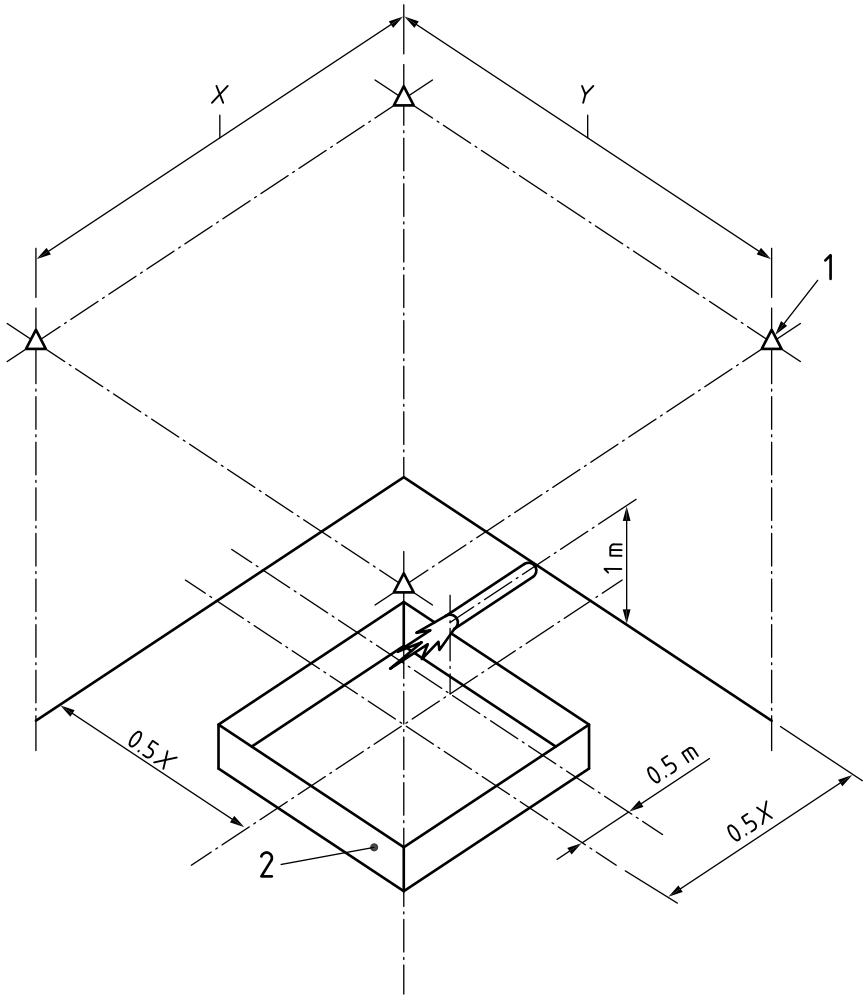
1 Nozzle

2 Pan, 4 m^2

X Manufacturer's maximum longitudinal nozzle spacing

Y Manufacturer's maximum latitudinal nozzle spacing

Figure 6 **Configuration for pool/spray fire arrangements in 8.1.1.4c)**



Key

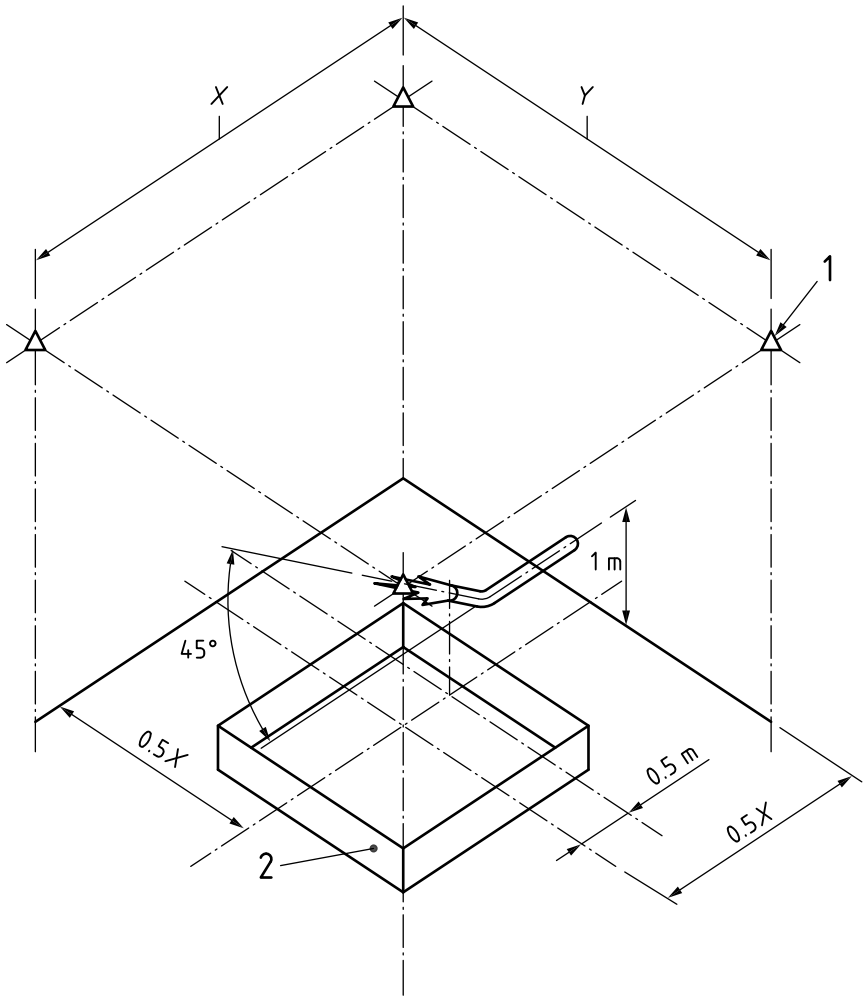
1 Nozzle

2 Pan, 4 m^2

X Manufacturer's maximum longitudinal nozzle spacing

Y Manufacturer's maximum latitudinal nozzle spacing

Figure 7 **Configuration for pool/spray fire arrangements in 8.1.1.4d)**



Key

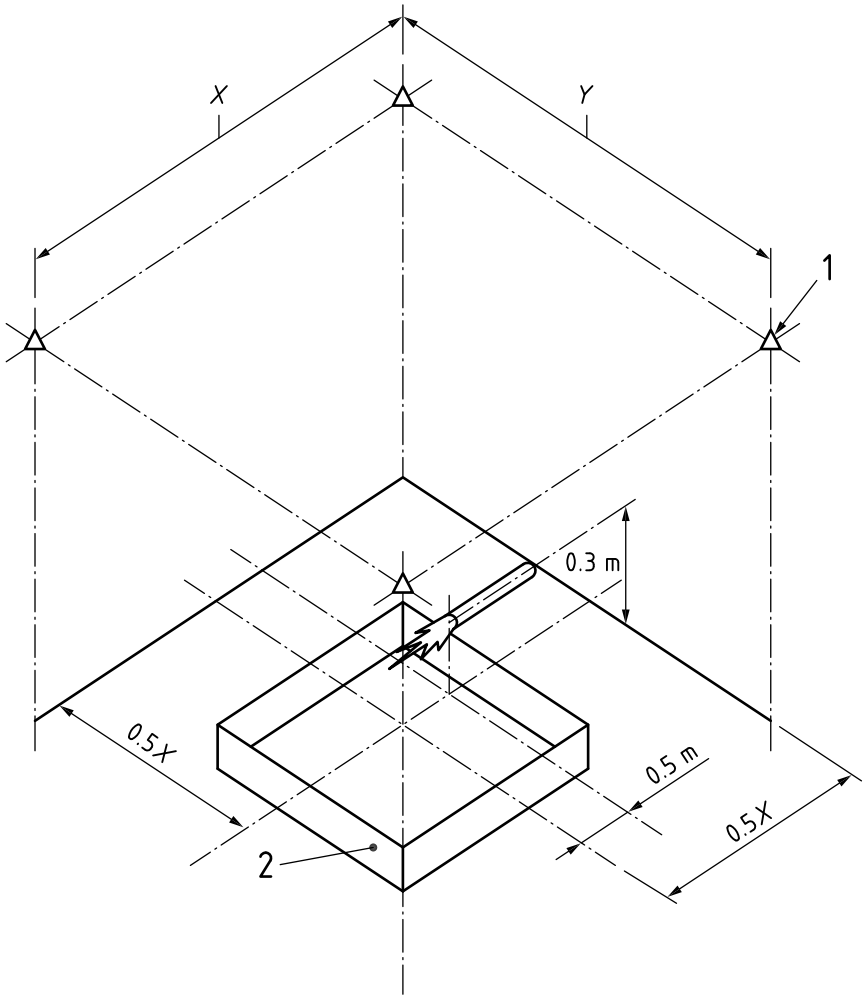
1 Nozzle

2 Pan, 4 m^2

X Manufacturer's maximum longitudinal nozzle spacing

Y Manufacturer's maximum latitudinal nozzle spacing

Figure 8 **Configuration for pool/spray fire arrangements in 8.1.1.4e)**



Key

1 Nozzle

2 Pan, 4 m^2

X Manufacturer's maximum longitudinal nozzle spacing

Y Manufacturer's maximum latitudinal nozzle spacing

9 Obstructed 3 m × 3 m square diesel pool fire

9.1 Test

9.1.1 Apparatus

*NOTE See the Note to **5.1.1** for tolerances.*

9.1.1.1 *Test hall*, as specified in **5.1.1.1**.

9.1.1.2 *Watermist system*, as specified in **5.1.1.2**.

9.1.1.3 *Test pool*, constructed in accordance with **5.1.1.3**, of size 3 m × 3 m.

9.1.1.4 *Obstruction*, comprising an empty closed-top-and-bottom metal drum, 208 L in capacity, 0.6 m × 0.9 m of standard 1.27 mm nominal thickness, which shall be placed 0.5 m over the centre of the pool. The drum shall be mounted on steel legs, as shown in Figure 9. Small ventilation holes shall be dispersed in the side of the drum to prevent over pressurization of the drum.

9.1.1.5 *Thermocouples*, as specified in **5.1.1.4**.

9.1.1.6 *Instrumentation*, to measure and record the parameters given in **5.1.1.5**.

9.1.1.7 *Additional baffles or obstructions*, if needed, to prevent the direct impact of mist on the pool fire.

9.1.1.8 *Stopwatch*.

9.1.2 Test conditions

The test conditions shall be in accordance with **5.1.2.1** to **5.1.2.10**.

9.1.3 Procedure

9.1.3.1 The test shall be conducted once with the nozzles at maximum height and once with the nozzles at minimum height.

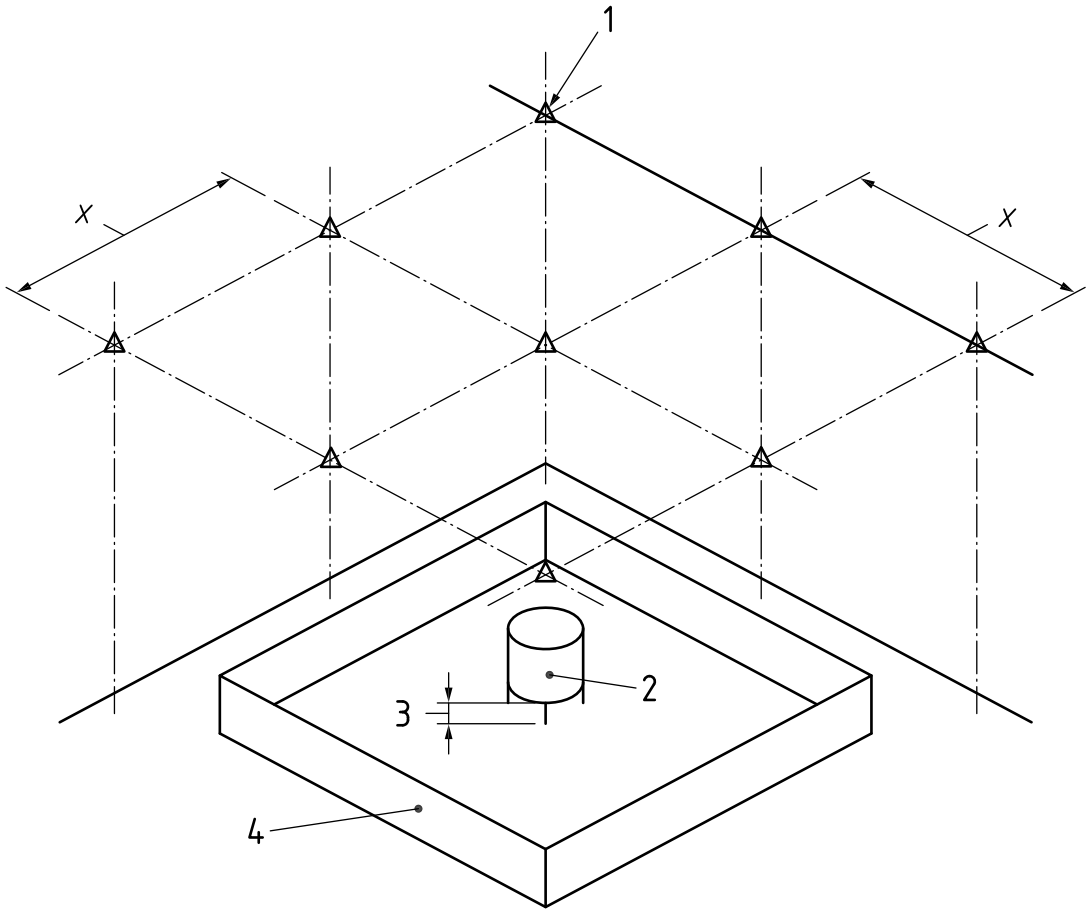
9.1.3.2 The procedures specified in **5.1.3.2** to **5.1.3.7** shall be followed, except that the pre-burn time specified in **5.1.3.4**b) is not needed.

9.1.3.3 Each test shall be repeated, and the results of both sets of tests (four in total) shall then be documented in a test report as specified in **5.1.3.8**, except that the statement of compliance/non-compliance specified in **5.1.3.8**j) shall refer to the pass/fail criteria in **9.2**.

9.2 Pass/fail criteria

When tested in accordance with **9.1**, the watermist system shall be deemed to have passed the test if the fires are extinguished during all four tests.

Figure 9 **Configuration for square diesel pool with obstruction**



Key

1 Nozzle

2 Metal drum, 208 L

3 Distance of drum above bottom of pan, 0.5 m

4 Pan, 9 m^2

X Manufacturer's maximum nozzle spacing

10 Offset 1 m × 1 m square diesel pool fire

10.1 Test

10.1.1 Apparatus

*NOTE See the Note to **5.1.1** for tolerances.*

10.1.1.1 *Test hall*, as specified in **5.1.1.1**.

10.1.1.2 *Watermist system*, as specified in **5.1.1.2**.

10.1.1.3 *Test pool*, constructed in accordance with **5.1.1.3**, of size 1 m × 1 m, configured as shown in Figure 1 but positioned in the location with the lowest flux density.

10.1.1.4 *Thermocouples*, as specified in **5.1.1.4**.

10.1.1.5 *Instrumentation*, to measure and record the parameters given in **5.1.1.5**.

10.1.1.6 *Additional baffles or obstructions*, if needed, to prevent the direct impact of mist on the pool fire.

10.1.1.7 *Stopwatch*.

10.1.2 Test conditions

The test conditions shall be in accordance with **5.1.2.1** to **5.1.2.10**.

10.1.3 Procedure

10.1.3.1 The test shall be conducted once with the nozzles at maximum height and once with the nozzles at minimum height.

10.1.3.2 The procedures specified in **5.1.3.2** to **5.1.3.7** shall be followed, except that the pre-burn time specified in **5.1.3.4**b) is not needed.

10.1.3.3 Each test shall be repeated, and the results of both sets of tests (four in total) shall then be documented in a test report as specified in **5.1.3.8**, except that the statement of compliance/non-compliance specified in **5.1.3.8**j) shall refer to the pass/fail criteria in **10.2**.

10.2 Pass/fail criteria

When tested in accordance with **10.1**, the watermist system shall be deemed to have passed the test if the fires are extinguished during all four tests.

11 Diesel pool fire, 2 m × 2 m square, combined with a 5.8 MW diesel spray fire, with an external ignition source

11.1 Test

11.1.1 Apparatus

*NOTE See the Note to **5.1.1** for tolerances.*

11.1.1.1 *Test hall*, as specified in **5.1.1.1**.

11.1.1.2 *Watermist system*, as specified in **5.1.1.2**.

11.1.1.3 *Test pool*, constructed in accordance with **5.1.1.3**, of size 2 m × 2 m.

11.1.1.4 *Conventional oil burner*, with the characteristics for a single 5.8 MW spray fire, as specified in **7.1.1.3**, and the nozzle tip mounting arrangements described in **8.1.1.4**a).

11.1.1.5 *External ignition source*, comprising an ordinary utility propane torch, positioned in a vertical plane perpendicular to the diesel nozzle axis and 2.85 m from the nozzle, as shown in Figure 10. The base of the 0.25 m long torch flame shall be 20 mm in diameter and shall be 0.75 m above the floor. The propane flame shall be slanted upwards at 30° to the horizontal. A 0.25 m wide × 1.25 m high × 3 mm minimum thickness steel plate shall be placed directly in front of the propane supply line. The horizontal standoff distance between the torch flame and the steel plate shall be 0.30 m.

11.1.1.6 *Fixture stand* as specified in **7.1.1.4**.

11.1.1.7 *Thermocouples*, as specified in **5.1.1.4** and **7.1.1.5**.

11.1.1.8 *Instrumentation*, as specified in **5.1.1.5** and **7.1.1.6**.

11.1.1.9 *Additional baffles or obstructions*, if needed, to prevent the direct impact of mist on the pool or spray fire.

11.1.1.10 *Stopwatch*.

11.1.2 Test conditions

The test conditions shall be in accordance with **5.1.2** and **7.1.2.2** to **7.1.2.4**.

11.1.3 Procedure

11.1.3.1 The test shall be conducted once with the nozzles at maximum height and once with the nozzles at minimum height.

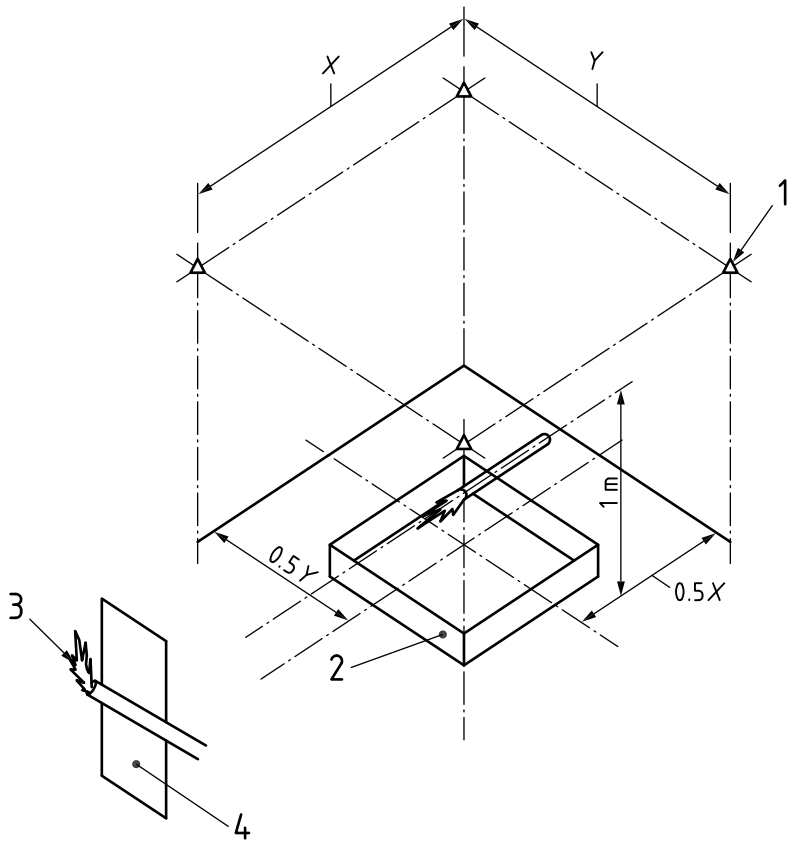
11.1.3.2 The procedures specified in **8.1.3.2** to **8.1.3.4** shall be followed.

11.1.3.3 The pool shall not be ignited. The watermist system shall be manually activated 15 s after ignition of the diesel spray by the propane torch.

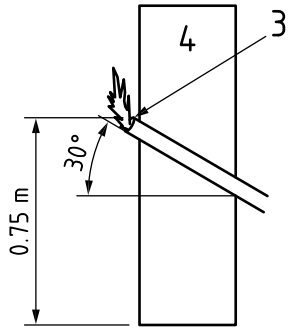
11.1.3.4 The procedures specified in **8.1.3.6** to **8.1.3.8** shall be followed.

11.1.3.5 Each test shall be repeated, and the results of both sets of tests (four in total) shall then be documented in a test report as specified in **5.1.3.8**, except that the statement of compliance/non-compliance specified in **5.1.3.8**j) shall refer to the pass/fail criteria in **11.2**.

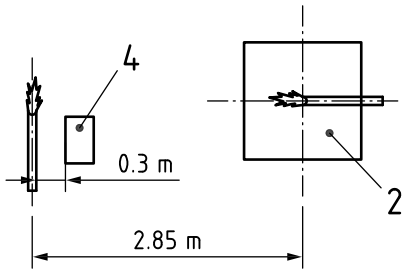
Figure 10 **Configuration for pool/spray fire with an external ignition source**



a) Isometric view



b) End view



c) Top view

Key

1 Nozzle

2 Pan, 4 m^2

3 Torch diameter, 25 mm

4 Steel plate, 0.25 m wide × 1.25 m high

11.2 Pass/fail criteria

When tested in accordance with **11.1**, the watermist system shall be deemed to have passed the test if the spray fires are extinguished during all four tests.

Bibliography

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 8489-5, *Fixed fire protection systems – Industrial and commercial watermist systems – Part 5: Tests and requirements for watermist systems for the protection of combustion turbines and machinery spaces with volumes up to and including 80 m^3*

BS 8489-6, *Fixed fire protection systems – Industrial and commercial watermist systems – Part 6: Tests and requirements for watermist systems for the protection of industrial oil cookers*

BS 8489-7, *Fixed fire protection systems – Industrial and commercial watermist systems – Part 7: Tests and requirements for watermist systems for the protection of low hazard occupancies*

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