K21045
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Specific Certification Program Fire Protection System - Components

for the Kiwa product certificate for nitrogen extinguishing generators for object protection

Trust
Quality
Progress

Preface

This specific certification program has been accepted by the Kiwa Board of Experts Fire Safety, in which all relevant parties in the field of Fire Protection Systems are represented. The Board of Experts also supervises the certification activities and where necessary requires the evaluation guideline to be revised. All references to Board of Experts in this evaluation guideline pertain to the above mentioned Board of Experts.

This certification program will be used by Kiwa in conjunction with the Kiwa Regulations for Certification within the context of Certification Scheme K21045 “Fire Protection Systems”.

Kiwa Nederland B.V.
Kiwa FSS
Dwarsweg 10
5301 KT Zaltbommel
The Netherlands
Tel. +31 88 998 51 00
Info.ncp@kiwa.nl
www.kiwafss.nl

2521.90605

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1 Introduction

1.1 General

This specific certification program includes all relevant requirements which are employed by Kiwa when dealing with applications for the issue and maintenance of a product certificate used for N2 nitrogen extinguishing generators for object protection.

This specific certification program is a first version and shall be used in context with product certification scheme K21045 “Fire Protection Systems”.
Since there is no standard or specific certification scheme for nitrogen generators, this program is based on relevant parts of the condensed Aerosol standards: EN 15276-1 and ISO 15779.
Also used are several part or principles from EN15004- part 1 and 8.

1.2 Field of application / scope

The generators are intended for total flooding use where there is a fixed enclosure around the hazard in order to enable the required concentration to be achieved and maintained for the required period of time and therefor to ensure an effective extinguishment of a fire within the enclosure. They are intended for normally unoccupied applications or as otherwise noted in individual listings. The nitrogen generated may create a potential hazard for personnel in the protected area. While generating nitrogen, there can be high temperature products of the extinguishing media discharged and this characteristic should be evaluated before the generators are installed.

Nitrogen extinguishant has been recognized as effective media for the extinction of Class A fires (solid surface burning fires) and Class B and Class C fires according to EN 2 but it should not be forgotten, in the planning of comprehensive schemes, that there can be hazards for which this medium is not suitable, or that in certain circumstances or situations there can be dangers in the use requiring special precautions.

1.3 Acceptance of test reports provided by the supplier

See TIC scheme K21045.

1.4 Quality declaration

See TIC scheme K21045.

2 Terms and definitions

See TIC scheme K21045.

3 Procedure for granting a product certificate

See TIC scheme K21045.
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4 Setup of this specific certification program

4.1 General

This chapter contains the setup for the specification certification program.
For the performance of its certification work, Kiwa is bound to the requirements as included in EN-ISO/IEC 17065 “Conformity assessment - Requirements for bodies certifying products, processes and services” and certification scheme K21045.
This program describes plans for Environmental and Extinguishing testing of Condensed Nitrogen Generators. It describes the test requirements and/or laboratories to be used for the testing, identifies the tests to be performed and provides in minimal schedules for test activities.

4.2 Product, Environmental and extinguishing requirements

4.2.1 Test of environmental requirements

- Low temperature test
- Rigidity and Activation of the Nitrogen forming compound
- Auto Activation of the nitrogen compound
- Auto activation of non-electrical thermal activation device
- Temperature and humidity operation range test
- Accelerated ageing test
- Corrosion test (Salt Spray)
- Stress corrosion test
- Mounting bracket test
- Vibration test
- Impact test
- Drop test
- Activation devices
- Fire exposure test

4.2.2 Tests of Extinguishing Requirements, reduced dimensions

- Minimum height/maximum coverage test
- Maximum height test
- Wood crib test, reduced dimensions
- N-Heptane pan test, reduced dimensions
- Polymeric sheet fire test, reduced dimensions (room only)
- Class A Compatible Wood Crib Test, reduced dimensions
- Composite wood fire test
- Test of the determination of the maximum leakage area/volume ratio
- Nitrogen Generator Explosive Atmosphere Test
- EN2, Class C, fires gas

4.2.3 Chemical stability of the fire extinguishing agent and extinguishing performance

The chemical composition shall be determined by the manufacturer or a laboratory and this formulation shall be recorded by Kiwa. All components of the product shall be clearly identified.

4.2.4 Function test (discharge/flow/temperature/casing/efficiency)

The object of the test is to demonstrate the ability of the nitrogen generator samples to continuously discharge in the given time with an expected flow / casing temperature and efficiency at room temperature

4.2.5 Excluded Tests, not applicable test cases

The following test cases are not applicable for the Nitrogen Generators subject of this specific certification program:

- Impact test (discontinued in EN15276-1)
- Composite wood test (discontinued in EN15276-1)
- Explosive Atmosphere Test (discontinued in EN15276-1)
- EN2, Class B, Large fire
- EN2, Class F, Fat fire

4.2.6 Additional general requirements

4.2.6.1 Test conditions

- The components shall be tested assembled as recommended for installation by the manufacturer. The tests shall be carried at a temperature of (25 ± 10)°C, except when otherwise stated.
- The tolerance for all test parameters is 5 %, unless otherwise stated.

4.2.6.2 Test samples

The manufacturer shall submit for tests a sufficient number, but not less than 55 [EN] samples from the same batch. From this number, 20 samples shall be tested according to the function test and a minimum of five (5) [ISO] generators in each size within a family shall be tested in the as-received condition for the function/discharge time test and includes the casing and nitrogen flow temperature tests

Unless otherwise noted, a minimum of two hundred (200) ignition devices of each type shall be tested for ignition performance test only.

A minimum of three (3) generators in the smallest and largest size within a family shall be tested for each of the following tests:

- temperature and humidity test;
- low temperature test;
- accelerated ageing test;
- corrosion test;
- stress corrosion test;
- vibration test;
- drop test and
- fire exposure test.

The number of generators for coverage determination will depend upon the installation limitations of each generator within a family.
A minimum of one (1) generator in each size within a family shall be tested for the minimum height/maximum coverage test.
A minimum of one (1) generator in each size within a family shall be tested for the maximum height test**.**

The number of generators and generator size for the extinguishing density determination will depend upon the area coverage limitations and generator efficiency. The generator having the smallest efficiency (that is, smallest amount of nitrogen extinguishing agent produced related to the generator's solid nitrogen-forming compound mass) shall be used.

The order of tests (with the exception of the compliance test and the functional test) may be changed by the testing authority.
In the test sample planning it is allowed to change the sequence of the tests (within limits and after consulting the testing authority). It's preferred to test the most severe situation. In that case some test samples will be submitted by more than one environmental test before the function will be tested.

The sequence of tests is shown in [EN] Table 1 / [ISO] C.1 and is given by the numbers 1, 2, 3, etc., in the table. A, B, etc., are the different samples

Test method / **Amount Samples**	**Generators for certification Test order for samples (with single test per sample)**										
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**M**
	3	**1**	**3**	**3**	**3**	**3**	**3+3**	**3**	**3**	**x**	**200**
Compliance	1	1	1	1	1	1	1	1	1	1	1
Low temperature test **(A)**	2		-		-	-	-	-	-	-	-
Coverage determination **(B)**	-	2	-			-	-	-	-	-	-
Temperature and humidity test **(C)**		-	2	-	-		-	-	-	-	-
Accelerated ageing test **(D)**	-	-		2		-	-	-	-	-	-
Corrosion test **(E)**	-	-	-		2		-	-	-	-	-
Stress corrosion test **(F)**	N/A, no brass part in generator design										-
Vibration test **(G)**	-	-		-		-	2	-	-	-	-
Drop test **(H)**			-	-	-	-	-	2	-	-	-
Fire exposure test **(I)**	-	-	-	-	-			-	2	-	-
Function test **(J)**	After each test and **20** generators in the as received condition.										
Activation performance test **(M)**	No generator required										2
Sub Total	**20+28**										
Extinguishing density determination Sub Total	Assumed is 15 or more (18?) generators per test 3.3.4 Wood crib test, reduced dimensions 3 tests 3.3.5 N-Heptane pan test, reduced dimensions 3 tests 3.3.6 Polymeric sheet fire test, reduced dimensions (room only) 3 tests 3.3.7 Class A Compatible Wood Crib Test, reduced dimensions 3 tests 3.3.9 Determination of the maximum leakage area/volume ratio 3 tests 3.3.11 EN2, Class C, Fires Gas 1 test 3x5x15=225 + 15 = 240										
Total	**Assumed minimum total of generators:** 240+20+28=**288** **Note:** In case of a failure during the **extinguishing density** determination tests each test represents a minimum of **15** generators. Therefor it's advisable to produce at least **60** generators extra. These numbers do **not include** the Pre Tests or other.										

Table [EN] Table 1 / [ISO] C.1 Test sequence

4.2.7 Traceability of Test Cases

All tests within this specific certification program are traceable to at least one of the standards in § 1.4 and all tests described into the condensed aerosol standards above will be met by the tests described within this specific certification program.

Example of a standard table, no relevant requirement or relation in EN15004-1 or 8

EN 15276-1	**ISO 15779**
Covers xx	-

Example of extra requirement or relation in EN15004-1

EN 15276-1	**ISO 15779**	**EN 15004-1**
-	-	Covers xx

Example of extra requirement or relation in EN15004-8

EN 15276-1	ISO 15779	EN 15004-8
Equals xx	-	Covers xx

The most severe tests of each standard will be tested. In the chapters below the tests to accomplish are laid down.

Equals: The test case in this document is equal to the referenced test case(s);
Covers: The test case in this document covers, requests a higher level of performance, goes beyond the referenced test case(s);
Partly: The test case in this document includes just a part of the referenced test case(s).

Therefor Equals represents the most severe test case!
Note that in some test cases parts of test cases are mixed in order to become the most severe test case or a test case witch will represent all standards!

Throughout all the parts of this specific certification program, the word “shall” indicates a mandatory requirement; the word “should” indicates a recommendation or that which is advised but not required.

5 Testing the performance of the components

5.1 Test method for product, environmental and extinguishing requirements

5.1.1 Chemical stability of the fire extinguishing agent and extinguishing performance

5.1.1.1 Traceability

EN 15276-1	ISO 15779	EN 15004-8
-	-	Covers 4

5.1.1.2 Test procedure

The chemical composition shall be determined by the manufacturer or laboratory and this formulation shall be recorded by Kiwa. All components of the product shall be clearly identified.

5.1.1.3 Nitrogen generating chemical

The composition of the nitrogen generating chemical shall be declared by the manufacturer or a laboratory for at least:

- Type of mixture
- Type of oxidizer(s)
- Type of binder
- Type(s) of additives
- Function of additives
- Basic production specifications

5.1.1.4 Generated Nitrogen Characteristics

The composition of the generated nitrogen shall be declared by a laboratory for at least the characteristics as mentioned in §4 of EN 15004-8.

The generated nitrogen should be equal to extinguishant IG-100 as specified in EN15004-8 §4. Deviations shall be noted.
Extinguishant IG-100 shall comply with the specification shown in Table 1.

Property	**Requirement**
Purity	99,6 % by volume, min.
Moisture	50 parts per million by mass, max.
Oxygen	0,1 % by volume, max.
NOTE Only principal contaminants are shown. Other measurements may include hydrocarbons, CO, NO, NO2, CO2, etc. Most are < 20 × 10^{-6}.	

Table [EN] §4 Table 1 Specification for IG-100

The physical properties are shown in Table 2.

Property	**Units**	**Value**
Molecular mass	-	28,02
Boiling point at 1,013 bar (absolute)	°C	–195,8
Freezing point	°C	–210,0
Critical temperature	°C	-
Critical pressure	bar abs	-
Critical volume	cm3/mol	-
Critical density	kg/m3	-
Vapor pressure 20 °C	bar abs	-
Liquid density 20 °C	kg/m3	-

Saturated vapor density 20 °C	kg/m3	-
Specific volume of superheated vapor at 1,013 bar and 20 °C	m3/kg	0,858
Chemical formula	N2	
Chemical name	Nitrogen	

Table [EN] §4 Table 2 Physical properties of IG-100

The CAS No. of IG100 is 7727–37–9.

5.1.1.5 Fail / Pass criteria
Inspection shows that there is a test report which fulfil above criteria.

5.1.2 Function test (discharge/flow temperature/casing/efficiency)

5.1.2.1 Traceability

EN 15276-1	ISO 15779
Equals 7.14.1, 7.12.2, 7.14.4, 7.14.5	Covers C.16.1, C.16.2, C.16.3, C.16.4

NOTE: Requirements according [ISO] and [EN] combined.
NOTE: it is allowed to test the Discharge/Flow Temperature/Casing/Efficiency test in a combined test set up.
NOTE: Discharge times from [EN15004-1] § 7.9.1.2 do not apply on nitrogen generators

5.1.2.2 Procedure Discharge time
A minimum of five generators in each size within a family shall be tested in the as-received condition.

Each sample shall be weighed and conditioned for at least 16 hours at 21 ±4°C and subjected to the below discharge test within 5 minutes of removal from the conditioning cabinet. Discharge the generator in a test enclosure.

Discharge time shall be measured by using one or more of the following techniques:
- thermocouples recording temperature changes at the start and end of the discharge;
- infrared video recording;
- generator combustion pressure.
- visual
- audible

NOTE: The reference points identified as the start and the end of the aerosol generator discharge should be the same as taken during performance testing and as defined by the manufacturer.

5.1.2.3 Test procedure Nitrogen flow temperatures
A minimum of five generators in each size within a family shall be tested in the as-received condition.

Each sample shall be weighed and conditioned for at least 16 hours at 21 ±4°C and subjected to the below flow temperatures test within 5 minutes of removal from the conditioning cabinet. Discharge the generator in a suitable test enclosure.

Nitrogen flow temperatures shall be measured by thermocouples. The following thermocouples arrangement shall be used for measuring temperatures at the specified minimum distances for 75 °C, 200 °C and 400 °C.
- three cross-shaped poles are used as a support for the thermocouples and installed at the specified minimum clearances;
- center of each cross should be in line with a center of a condensed nitrogen generator's discharge outlet with the ends of the cross being within the cone-shaped discharge path;

- crosses may be rotated against each other (i.e. X, Y, Z axis) to minimize the impact of the nitrogen flow on the temperature readings;
- five thermocouples may be used – one at the center of the cross, and four at its ends;
- three highest readings out of five shall be taken for recording.

Any other than above described suitable measuring technique acceptable to and approved by Kiwa may be used for measuring discharge time, temperatures and enclosure pressure.

5.1.2.4 Test procedure Casing temperature test

A minimum of five generators in each size within a family shall be tested in the as-received condition.

Each sample shall be weighed and conditioned for at least 16 hours at 21 ±4°C and subjected to the below casing temperature test within 5 minutes of removal from the conditioning cabinet.

Discharge the generator in a suitable test enclosure.

Casing temperatures higher than 75°C shall be treated as flow temperatures for 75 °C, 200 °C and 400 °C except for the thermocouples arrangement as described in 3.2.3.4

If a significant rise in temperature of the casing is to be expected within the 30 minutes after discharge the maximum temperature and time after discharge for reaching this temperature shall be noted.

The following thermocouples arrangement may be used for measuring temperature of the outer generator's casing.

- Three thermocouples should be attached to the outer casing of the nitrogen generator in the locations with the highest expected temperature.

5.1.2.5 Test procedure Efficiency

A minimum of five generators in each size within a family shall be tested in the as-received condition.
Each sample shall be weighed and conditioned for at least 16 hours at 21 ±4°C and subjected to the below efficiency test within 5 minutes of removal from the conditioning cabinet.
Discharge the generator in a suitable test enclosure.

The efficiency of any type of nitrogen generator shall be calculated using the following formula:

Formula
(Mb – Ma) / Mc x 100 = efficiency of an nitrogen generator

The efficiency of any type of nitrogen ≥ 100 will be declared at 100%.

Abbreviation		Unit
Mb	Mass of the nitrogen generator before activation	gram
Ma	Mass of the nitrogen generator after activation	gram
Mc	Mass of the compound in the nitrogen generator according specification of the manufacturer	gram
Efficiency	actual amount of nitrogen extinguishing agent in the enclosure after discharge	%

Calculating the efficiency of the generator provides in the actual amount (extinguishing density) of nitrogen extinguishing agent in the enclosure.

5.1.2.6 Fail / Pass criteria

Nitrogen generator samples shall operate as intended. Discharge shall not result in permanent deformation of the nitrogen generator.
Nitrogen generator samples shall comply to the conditions and requirements as described in Table 2/C.3 below.

Test conditions for Discharge/Flow Temperature/Casing/Efficiency test		
EN 15276-1, Table 2 and ISO 15779, Table C.3		
Parameter	Requirement	Tolerance
Visual examination	During discharge: no flame coming out from discharge outlet	---
Discharge time	As specified by manufacturer and shall not exceed 90 s.	20 % or ± 5 s (whichever is greater)
Temperatures at the specified minimum clearances for 75°C, 200°C and 400°C	As specified by manufacturer	Less or equal
Temperature of the outer casing	As specified by manufacturer	Less or equal
Efficiency / Mass of nitrogen compound discharged	Related to the average at 21 °C	-0% / +5%

5.1.3 Low temperature test

5.1.3.1 Traceability

EN 15276-1	**ISO 15779**
Equals 7.6.3	Covers C.7.3

NOTE: 16 hours at -20 according [ISO], where [CEN] requires -20 or the service temperature recommended by the manufacturer

5.1.3.2 Test procedure

A minimum of three generators in the smallest and largest size within a family shall be tested.

Condition the samples at (-20 +0/-2) °C, or the service temperature recommended by the manufacturer whichever is the lower, for a minimum of 16 h.

After the condition period, the sample shall be subject to the Function Test within 5 minutes of removal from the conditioning temperature.

5.1.3.3 Fail / Pass criteria

When subjected to the Function Test, the sample shall respond correctly.

5.1.4 Auto activation of non-electrical thermal activation device

5.1.4.1 Traceability

EN 15276-1	**ISO 15779**
Covers 7.13	Covers C.15

NOTE: This test takes 200 samples according [ISO] where [EN] requires no further specified number of samples.

5.1.4.2 Test Procedure

The objective of the test is to demonstrate the quality, rigidity and consistency of the non-electrical thermal activation device.
The non-electrical thermal activation device is stored at -50°C. After this period the non-electrical thermal activation device is removed from the cabinet and shall not fragment. The temperature of

the non-electrical thermal activation device is then increased in steps of 10°C. Once a temperature stage is reached, it shall be maintained for at least 10 minutes. Above 150°C the temperature steps shall be decreased into steps of 5°C.

Remark:

- The non-electrical thermal activation device shall be submitted to the test outside the nitrogen generator (or not installed)
- 200 samples of the non-electrical thermal activation device shall be tested and operate as intended according and in analogy with ISO 15779
- The non-electrical thermal activation device can contain a binder whose function may be impaired at low temperatures. Specifically when it is based on nitrogen compound.
- The activation of the generator shall be tested in accordance with the manufacturer's specifications.
- All samples of the complete activation devices shall operate as intended. If the activation device is a commercially/military available component with reliability test data, that data can be used to satisfy this requirement, at the discretion of the listing organization/certification body.
- The power output of the activation device shall be not less than that specified by the manufacturer at minimum power output sufficient to activate the maximum designed mass of the nitrogen-forming compound at the lowest operating temperature specified by the manufacturer.

5.1.4.3 Pass / fail criteria:

- The non-electrical thermal activation device shall not fragment after being conditioned at -50°C;
- The non-electrical thermal activation device shall demonstrate auto activation between the temperatures specified by the manufacturer.

5.1.5 Temperature and humidity operation range test

5.1.5.1 Traceability

EN 15276-1	**ISO 15779**
Covers 7.6	Equals C.7.2

NOTE: The test in ISO] describes a hold time between the tests where [EN] does not.

5.1.5.2 Test procedure

The object of the test is to demonstrate the ability of the equipment to function correctly at high relative humidity (with condensation) which may occur for short periods in the anticipated service environment.

The test procedure as described in EN IEC 60068-2-30:2005, using the variant 1 test cycle and controlled recovery conditions shall be used.

Apply the following severity of conditioning:

- lower temperature: (25 ± 3) °C
- upper temperature: (55 ± 2) °C
- relative humidity at lower temperature: (93 ± 3) %
- relative humidity at upper temperature: (93 ± 3) %
- number of cycles: 10
- Hold time at temperature and recovery time before each test shall be 12 h ± 0.5h

After the recovery period, the sample shall be visually checked for mechanical damage externally, and shall be subjected to the function test.

5.1.5.3 Fail / Pass criteria

When subjected to the function test, the sample shall respond correctly.

5.1.6 Accelerated ageing test

5.1.6.1 Traceability

EN 15276-1	ISO 15779
Equals 7.7	Covers C.8

NOTE: The test in ISO] describes a service life shorter than the test time in [EN].

5.1.6.2 Objective of test

Procedure to establish the service life of condensed nitrogen generators.
The objective of the test is to demonstrate the ability of the condensed nitrogen generators to function correctly during the service life period of 15 years when stored in a dry, non-corrosive environment. The service life period includes the storage and installation life period for the product. This test is used for several materials of construction. The stability of the molecular structure of the material is tested by the temperature cycles. During each cycle the material passes the dew point which will lead to condensation on the exterior of the object. During the cold period this can lead to freezing in hairline cracks in the material which can affect the structure of the material. In use the components are not exposed to rain, i.e. they are not exposed to a full water load, but they can be affected by condensation, which is simulated by this test. This thermal ageing method is intended to obtain information about the long-term behavior of materials in the short-term. The effect of this on the fire extinguishing performance is realistic and functional.

5.1.6.3 Performance requirements

The service life period is determined by thermal aging. The condensed nitrogen generator and activator is tested in its original housing including vibration
bracket. The nitrogen generator is placed in a temperature and humidity controlled cabinet in which the temperature can be cycled (aging cabinet). After the test is completed, the performance of the nitrogen generator is determined in accordance with the function test.

5.1.6.4 Test procedure

The following test shall be performed.

Aging cabinet settings:

- Start from ambient temperature and set a humidity of 70 %;
- set to −10 °C and then to 50 °C (±2 °C) and alternate between these temperatures every 4 h
- one cycle amounts to a full transition from −10 °C to 50 °C, and then back to −10 °C within 8 h;
- number of cycles is 50.

End from −10 °C to ambient temperature.

5.1.6.5 Fail / Pass criteria

When subjected to the function test, the sample shall respond correctly.

5.1.7 Corrosion test (Salt Spray)

5.1.7.1 Traceability

EN 15276-1	ISO 15779
Equals 7.8	Equals C.9

NOTE: The mounting bracket shall be tested together with the generator for corrosion, vibration and mechanical shock impact.

5.1.7.2 Test procedure

The sample shall be exposed to a salt spray within a fog chamber.

The essential components and properties of the reagents and the test configuration are:

- Solution consists of NaCl in distilled water;
- Concentration of the solution: (5 ± 1) %;
- pH Value: 6,5 to 7,5;
- Spray pressure: 0,6 to 1,5 bar;
- Spray volume: 1 ml/h to 2 ml/h on an area of 80 cm2;
- Temperature in test cabinet: (35 +1,0/-1,7) °C;
- Position of the sample: 15° to the vertical axis;
- Spray time: (240 ± 2) h;
- Drying time: (168 ± 5) h at a humidity of maximum 70 %.

Following the exposure the sample shall be subjected to the function test.

5.1.7.3 Fail / Pass criteria

When subjected to the function test, the sample shall respond correctly.

5.1.8 Stress corrosion test

5.1.8.1 Traceability

EN 15276-1	ISO 15779
Equals 7.9	Equals C.10

NOTE: The mounting bracket shall be tested together with the generator for corrosion, vibration and mechanical shock impact.

5.1.8.2 Test procedure

This test is to be conducted only on generators using copper alloys. The stress corrosion test is to be conducted unless it can be shown to the listing authority that the materials used in the construction are not susceptible to ammonia stress corrosion.

The aqueous ammonia solution shall have a specific weight of (0,94 ± 0,02) kg/l. The sample shall be filled with (10 ± 0,5) ml of the solution for each liter of container volume.

The samples shall be degreased for the test and shall be exposed for 10 days to the moist atmosphere of ammonia and air, at a temperature of (34 ± 2) °C. The samples shall be positioned (40 ± 5) mm above the level of the liquid.

After testing, the samples shall be cleaned and dried and subjected to careful visual examination. To make cracking clearly visible, the liquid penetration method shall be used.

5.1.8.3 Fail / Pass criteria

To make cracking clearly visible, the liquid penetration method shall be used.
Cracks are unacceptable, resulting in test failure.

5.1.9 Mounting bracket test

5.1.9.1 Traceability

EN 15276-1	ISO 15779
-	-

5.1.9.2 Test procedure

The fixing system or mounting bracket shall not be tested together with the nitrogen generator.

The fixing system or mounting bracket shall be installed on a wall or ceiling in accordance with the supplier's instructions. A weight of at least five times the weight of the actual nitrogen generator (minimum 100 g) is secured to the fixing system or mounting bracket. This shall be maintained for 10 minutes.

During the test the screws, plugs and the physical condition of the ceiling are not directly tested. The fire extinguishing system is intended for a rapid response and extinguishing action. Maintaining its functionality for more than e.g. 15 minutes of the fixing system or mounting bracket is not relevant.

Fail / Pass criteria

The fixing system or mounting bracket of the nitrogen generator (minimum 100 g) shall withstand a load equivalent to the weight of the nitrogen generator multiplied by a factor of five without visible distortion for 10 minutes.

5.1.10 Vibration test

5.1.10.1 Traceability

EN 15276-1	ISO 15779
Equals 7.10	Equals C.11

NOTE: The mounting bracket shall be tested together with the generator for corrosion, vibration and mechanical shock impact.

5.1.10.2 Test procedure

The drawings and the technical data shall be checked to determine whether vibration could have an adverse effect on the performance of the non-electrical activation or disable device.

If necessary, vibration tests shall be carried out either in the standby position, loaded position or unlocked position.

Each sample is to be mounted in its bracket or a test fixture and secured to the vibration-test apparatus in an orientation simulating intended installation.

The test apparatus and procedure shall be as described in EN 60068-2-6:2008, Test F_c:

Frequency range:

- 10 Hz to 150 Hz

Acceleration amplitude for components which are designed to be attached to machinery:

- 10 Hz to 50 Hz: 9,81 m/s2 (= 1,0 g_n);
- 50 Hz to 150 Hz: 29,43 m/s^2 (= 3,0 g_n).

Acceleration amplitude for components which are designed to be attached to walls:

- 10 Hz to 50 Hz: 1,962 m/s^2 (= 0,2 g_n);
- 50 Hz to 150 Hz: 4,905 m/s^2 (= 0,5 g_n).

Sweep rate:

- 1 octave per 30 min

Number of sweeps:

- 0,5 per axis

Number of axes:

- 3 mutually perpendicular

5.1.10.3 Fail / Pass criteria

The sample shall not operate during the test as a result of the vibrations. The sample shall be inspected for external mechanical damage. No deterioration or detachment of parts shall occur. Not experience physical deterioration or malfunction of components to the extent that requires replacement.
Nitrogen generators of automatic extinguisher generators shall be evaluated with the intended activation device. After vibration, each nitrogen generator sample shall be subjected to the Function Test. When subjected to the function test, the sample shall respond correctly.

5.1.11 Drop test

5.1.11.1 Traceability

EN 15276-1	**ISO 15779**
Equals 7.11	Equals C.13

5.1.11.2 Test procedure

The impact surface is a solid base with a reasonably smooth surface. An example of such a surface is as follows:

- steel plate, with a minimum thickness of 75 mm and Brinell hardness of not less than 200, solidly supported by a concrete foundation having a minimum thickness of 600 mm.

The length and width of the surface should be not less than one and a half times the dimension of the unit being tested.

The test unit without packaging is dropped from a height of 2 m as measured from the lowest point of the test unit to the impact surface. A safe waiting period following impact prescribed by the test laboratory should be observed, even if no visible initiation or ignition occurs at impact.

Following the drop test the sample shall be subject to the function test.

5.1.11.3 Fail / Pass criteria

When subjected to the function test, the sample shall respond correctly.

5.1.12 Activation performance test

5.1.12.1 Traceability

EN 15276-1	**ISO 15779**
Covers 7.13	Covers C.15

NOTE: This test takes 200 samples according [ISO] where [EN] requires no further specified number of samples.

5.1.12.2 Test procedure

The activation of the generator shall be tested in accordance with the manufacturer's specifications. All samples of the complete activation devices shall operate as intended. If the activation device is a commercially/military available component with reliability test data, that data can be used to satisfy this requirement, at the discretion of the listing organization.
The power output of the activation device shall be not less than that specified by the manufacturer at minimum power output sufficient to activate the maximum designed mass of the nitrogen-forming compound at the lowest operating temperature specified by the manufacturer.
Ignitors already certified by a recognized authority for ignition reliability will be not re-tested.

Fail / Pass criteria
The activation devices operate as specified.

5.1.13 Fire exposure test

5.1.13.1 Traceability

EN 15276-1	ISO 15779
Replaces 7.15	Equals C.17

5.1.13.2 Test procedure

Each sample shall be weighed (+/- 5 gram) and installed in a mounting bracket such that the bottom most portion of the generator is centered 915 ± 15 mm above the bottom of the pan specified in 5.1.18.5.

For each test, at least 1.5 cm of heptane is to be placed in the pan, ignited and burnt for at least 60 seconds. During or after fire exposure, each nitrogen generator sample shall be discharged as described in the Function Test, except the environmental condition need not to be maintained at 21 ± 4 °C.

5.1.13.3 Fail / Pass criteria

The nitrogen generator unit shall:

- Operate as intended;
- Have a discharge time within ±20 percent or ±5 seconds (whichever is greater) of the average discharge time determined at 21 ±4°C (70 ±7°F); and
- Have an agent discharge quantity at list 90 % of the average agent discharge quantity determined at 21 ± 4°C

The discharge time shall be in accordance with the function requirements as specified in the Function test

5.1.14 General extinguishing requirements, reduced dimensions

The extinguishing application density/coverage tests shall be carried out in accordance with Table A.1 [EN] and D.1 [ISO]**Test objective**	**Enclosure size**	**Test fires**	**Test in accordance with**
Nitrogen generator distribution verification: **Min. Height/max protected volume and distance** **Max. Height/Max protected volume and distance**	**To suit nitrogen generator's unit size**	**Heptane test pans**	**5.1.18** **5.1.16**
Extinguishing density determination	**≥ 33 m³ No side less than 3m, height: not less than 3 m**	**(a) Wood crib**	**5.1.17**
		(b) N-heptane pan	**5.1.18**
		(c) Polymeric sheet (i) PMMA (ii) Polypropylene	**5.1.19**
		(d) Class A Compatible wood crib test	**5.1.20**
Hold time, maximum leakage area/volume ratio	**≥ 33 m³ No side less than 3m, height: not less than 3 m**	**n-heptane test pan**	**5.1.22**

Table A.1 [EN] and D.1 [ISO] - Tests

5.1.14.1 Principle

1) An nitrogen generating system shall mix and distribute its extinguishant and shall totally flood the enclosure when tested in accordance with this or additional test methods under the maximum design limitations and most severe installation instructions (See also ad 2).

2) **The tests will be performed in an enclosure with a size of approx. 33 m3 instead of the ≥100 m3 as a mandatory enclosure size in the standards for aerosols and gaseous extinguishants.**

   NOTE: the actual measurements of the test enclosure are 3 x 4 x 3 (W x L x H) which results in a volume of 36m³.

3) When tested as described in 5.1.15, 5.1.16 and 5.1.18 an extinguishing system unit shall extinguish all visible flaming within 30 s after the end of extinguishant discharge.

   When tested as described in 5.1.17 and 5.1.23 an extinguishing system unit shall extinguish all visible flaming and prevent re-ignition of the fires after an 10 min soak period (also measured from the end of extinguishant discharge).

   When tested as described in 5.1.19, an extinguishing system unit shall "knock down" the flames within 60 s of the end of extinguishant discharge (that means there are only flames allowed at the top edges of the two inner sheets) and extinguish all visible flaming within 3 min of the end of extinguishant discharge and also prevent re-ignition of the fires after a 10 min soaking period (also measured from the end of extinguishant discharge).

4) Measures shall be taken to avoid effects of blowing out the fire leading to positive results of the extinguishing test. Jet energy from the discharge outlets shall not influence the development of the fire. Therefore, the discharge outlets shall be directed away from the fires.

5) The tests described herein consider the intended use and limitations of the extinguishing system unit, with specific reference to:
    a) the coverage for each nitrogen generator unit size;
    b) the maximum and minimum height of the protected enclosure for each nitrogen generator generators size;
    c) location of nitrogen generators in the protected area;
    d) maximum pressure built up during discharge;
    e) maximum discharge time;
    f) extinguishing factor for specific fuels.
    g) The maximum leakage area to volume ratio that ensures compliance with the hold time requirements.

5.1.14.2 Test can dimensions and use during tests

The text in the standards EN 15276-1 and ISO 15779 is not entirely clear and therefor leads to possible improper use of the test cans as mentioned caused by interpretation.

The following requirements on or use of the test cans supersedes the text in the standards and shall be applied during the tests in this protocol.

- Test cans shall have a measurement of 80-85 mm in diameter and 100-110 mm in height.
- Test cans shall be made of mild or stainless steel with a thickness of 5 mm to 6 mm.

Regarding the use of the test cans during the tests as described in the tests in table A.1 / D.1 and text below, for the coverage test and other fire extinguishing tests the proper use of the test cans is given in this paragraph and supersedes the text in the standards.

Nitrogen generator distribution verification:
Test enclosure dimensions to be determined, generator specific tests 5.1.18 and 5.1.19

- Test cans without baffles and within 300mm from top and bottom during the “coverage” tests => Max height and Min height / Max coverage (generator specific tests)

Extinguishing density determination:
36 M3 test enclosure, non-generator specific N-Heptane test 5.1.21

- With baffles and the bottom of the cans is to be positioned 400 mm to 500 mm below the ceiling for the four upper test cans, 400 mm to 500 mm above the bottom for the lower test cans during the fire extinguishing tests.

5.1.14.3 Test cans and their function in relation to the N-Heptane test

In addition to the main test object, eight test cans filled with n-heptane shall be positioned in the upper and lower corners of the test room.
Important is also the correct notation of the **“main pan”** and the function of the test cans in the N-Heptane test itself

The heptane is to be ignited and allowed to burn for 30 s.
The heptane in the test cans shall be ignited at the same time or before the main pan. The first test can shall be ignited at a maximum of 60 s before the main test object.
After 30 s all openings are to be closed and the extinguishing system is to be manually actuated. At the time of actuation of the system, the amount of oxygen within the enclosure shall not be more than 0,5 vol% lower than the normal atmospheric oxygen concentration. During the test, the oxygen concentration shall not change by more than 1,5 vol% due to fire products. This change shall be determined by comparing the oxygen concentration measured in the cold discharge test with the oxygen concentration measured in this fire test (averaged values).
The test is only positive if the main test object is extinguished later than the test cans are extinguished or at a maximum of 10 s earlier.

5.1.14.4 Homogenous distribution transfer from the N-heptane test to the others

The homogenous distribution shall be verified by test cans when testing in accordance with all tests except 5.1.18 and 5.1.19 and 5.1.21

The homogenous distribution **is demonstrated** by the test cans as described in the N-Heptane tests. In the tests according to 5.1.17, 5.1.19 and 5.1.20, the same type, size and placement of generators (except for test 5.1.24 regarding the placement), shall be used in order to transfer the verified homogenous distribution from the N-Heptane pan test to the others.
The oxygen concentration is permitted to be measured at the locations specified for the steel test cans. The concentration shall be measured at each location and shall be at least the extinguishing concentration, to be reached 30 s after end of discharge time at latest.

NOTE: See 5.1.21.9 Test procedure of N-Heptane test

The exact volume shall match the intended application quantity of the extinguishing units used for the test described in 5.1.22.

5.1.14.5 Extinguishing system

1) For the extinguishing tests described in 5.1.17, 5.1.18, 5.1.19, and 5.1.20, jet energy from the discharge outlets shall not influence the development of the fire. Therefore the discharge outlets shall be directed away from the fires.
2) Adequate pressure relief vents in form of e.g. closable flaps shall be provided during all tests and shall be capable to eliminate a pressure difference of 200 Pa minimum. Calculations for the minimum vent area as well as location of the vents shall be in accordance with manufacturer's specifications.

5.1.14.6 Extinguishing density

The extinguishing application density for each test is to be 76,9 % ([ISO] / [EN]) of the intended end use design density specified in the manufacturer's design and installation instructions at the ambient temperature of (20 ± 5) °C within the enclosure. In the tests described in 5.1.18 and 5.1.16, the same extinguishing application density shall be used as in the tests described in 5.1.18. The density for test described in 5.1.21. is to be the intended end use design application density specified in the manufacturer's design and installation instructions at the ambient temperature of (20 ± 5) °C within the enclosure.

In the tests according to 5.1.17, 5.1.18, 5.1.19, and 5.1.20, it is necessary to ensure that the main test object has been extinguished by the agent density and that the agent is distributed homogenously.

5.1.15 Minimum height / maximum coverage test

5.1.15.1 Traceability

EN 15276-1	ISO 15779	EN 15004-1
Equals A.5.1	Covers D.5.1	Covers C.5.1

NOTE: Configuration of test environment according [EN] and [ISO] ;
NOTE: Test facility described requirements for volume; parameter C [EN] and Rmax [ISO] are the same. [ISO] is used.

NOTE: "2)The distance c (see Figures A.1/D.1 and A.2/D.2) shall be equal to maximum coverage distance (Rmax) specified by manufacturer." Is a measure from the previous version of the standard. In the current drawings there is no distance "C".
NOTE: The extinguishing density for n-heptane, determined according to 3.3.5 shall be used
Note: Sampling and storage of data according EN15004-1; C5.1.1.2

5.1.15.2 Test Facility Construction

The test enclosure shall meet the following requirements:

a) The area (a × b) and height (H) of the enclosure (see Figure D.1) shall correspond to the maximum area coverage and minimum height specified by the manufacturer for a specific nitrogen generator unit size,

b) Test room volume shall be determined from the result of heptane fire test (see 5.1.18)

- $V_{test} = M / (0.769 \cdot Rmax)$ [m³] (Figure A.1 [EN] and D.1 [ISO])

Where:
M is the generator's unit mass in grams

Rmax is the design density, in grams per cubic meter

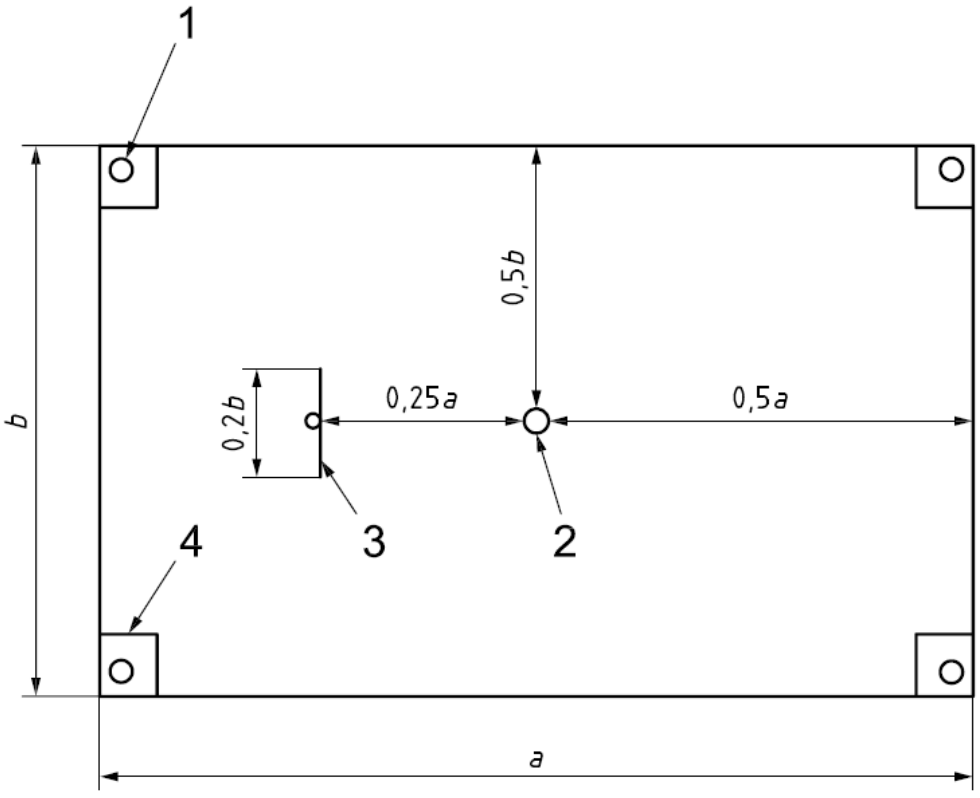
c) Area sides a and b shall be calculated to fulfill following requirements:

- $A \times b = V_{test} / H$ (Figure A.2 [EN] and D.2 [ISO])

d) Means of pressure relief shall be provided to limit the pressure change with a cold discharge to ± 300 Pa.

e) Closeable openings shall be provided directly above the test pans to allow for venting prior to system actuation.

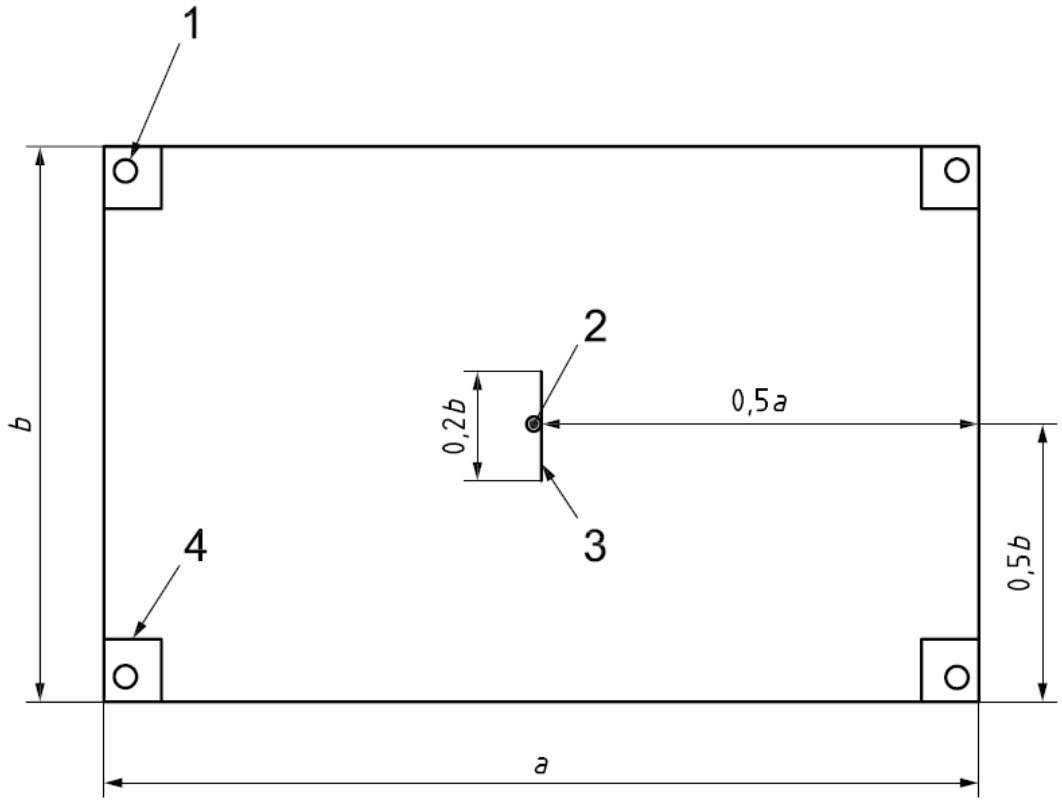
f) One baffle is to be installed between the floor and ceiling with the height of the room. It is to be installed halfway between the discharge outlet location and the walls of the enclosure (see Figure A.1/D.1 for center mounting generator and Figure A.2/D.2 for side mounting generator). The baffle is to be perpendicular to the direction between the discharge outlet location and walls of the enclosure (see Figures A.1/D.1 and D.1/D.2), and be 20% of the length of the short wall of the enclosure.



Key

a × b	maximum generator area coverage for a single generator		
1	Test pans	3	Baffle
2	Generator	4	Vents

Figure A.1 [EN] and D.1 [ISO] — Example configuration for Generator minimum height/ maximum coverage test for center mounting generator



Key

a × b	maximum generator area coverage for a single generator		
1	Test pans	3	Baffle
2	Generator	4	Vents

Figure A.2 [EN] and D.2 [ISO] — Example configuration for Generator minimum height/ maximum coverage test for side mounting generator

5.1.15.3 Instrumentation

Sampling and storage of data from the sensors described below shall occur at a rate of at least 1 Hz.

5.1.15.4 Oxygen concentrations

The oxygen level (minimal oxygen level as per 5.1.15.15) shall be measured by a calibrated oxygen analyzer capable of measuring the percentage oxygen to within at least one decimal place (0,1%). The sensing equipment shall be capable of continuously monitoring and recording the oxygen level inside the enclosure throughout the duration of the test. The accuracy of the measuring devices shall not be influenced by any of the fire products.

At least three sensors shall be located within the enclosure (Figures D.3 and D.4). The three sensors shall be located in a horizontal distance from the center of the room 850 mm to 1 250

mm and in the following heights: 0,1 × H, 0,5 × H and 0,9 × H (H = height of the enclosure) above the floor.

5.1.15.5 Discharge pressure

The pressure built up during system discharge shall be measured and recorded by a pressure transducer at a distance not greater than 1 m from the generator.

5.1.15.6 Enclosure temperature

At least the temperature in a horizontal distance from the center of the room of 850 mm to 1 250 mm and 0,5 × H (H = room height) above the floor shall be recorded (Figures A.3/D.3 and A.4/D.4).

NOTE: It is recommended to use K type thermocouples (Ni-CrNi), diameter 1 mm.

5.1.15.7 Nitrogen temperature and discharge times

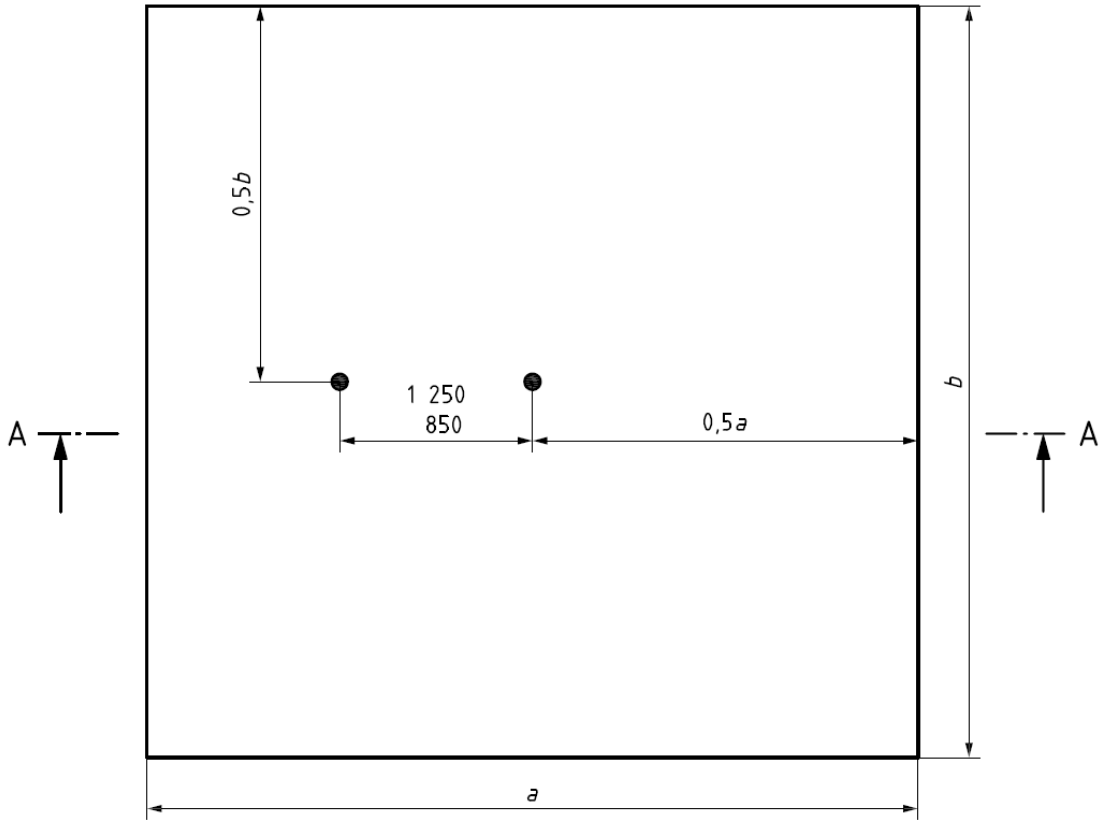
A thermocouple shall be placed just outside the discharge outlet of the nitrogen generator to record nitrogen temperature at the outlet as well as commencement and end of the nitrogen discharge. Additional thermocouples may be placed at the minimum thermal clearance from the discharge outlet as specified by the manufacturer for each unit size of the nitrogen generators.

NOTE: It is recommended to use K type thermocouples (Ni-CrNi), diameter 1 mm.

5.1.15.8 Flame out times

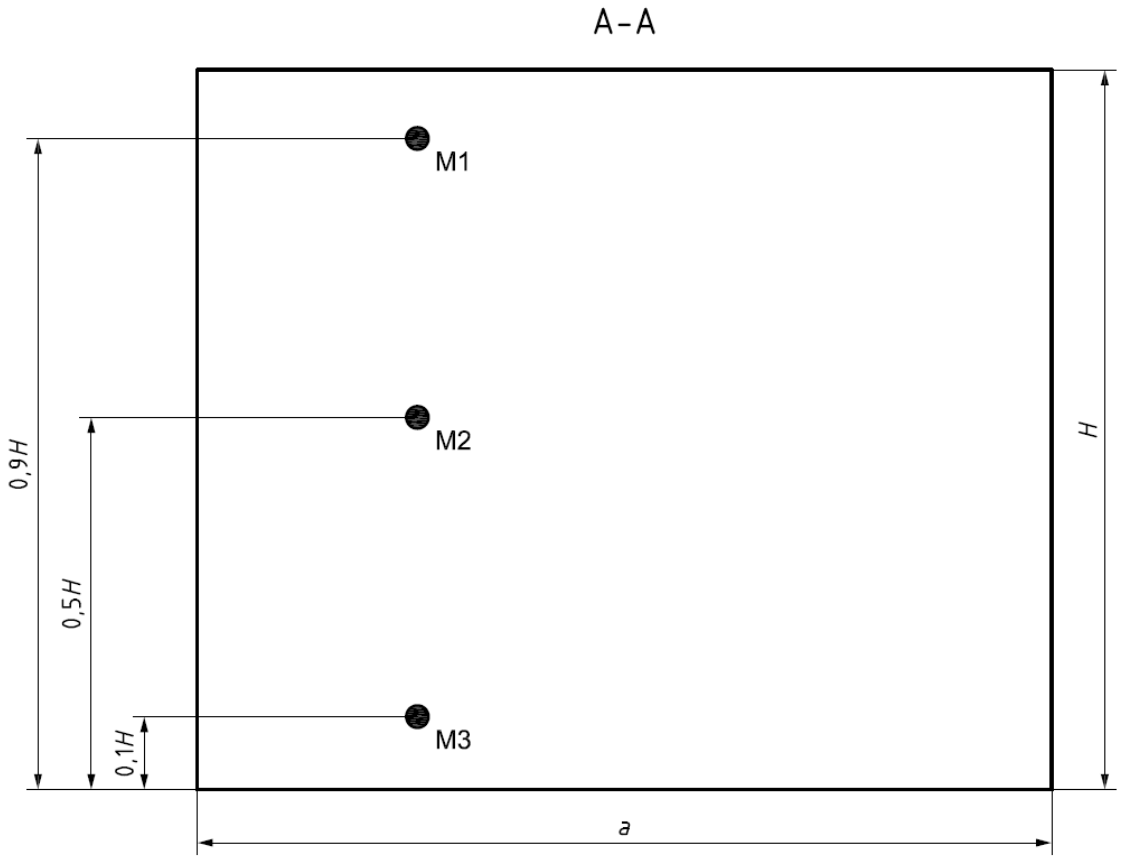
Cameras, e.g. infrared-cameras, or an alternative means of directly viewing the fire can be provided as an aid to determining flame out times.

A thermocouple can be located centrally 30 mm above each fire pot to provide additional information.



Dimensions in millimeters

Figure A.3 [EN] and D.3 [ISO] — Plan view of instrumentation placement for generator minimum height/maximum area coverage and maximum height/maximum area coverage test



Key
M1 At measuring point 1, record the O2 concentration.
M2 At measuring point 2, record the O2 concentration and temperature.
M3 At measuring point 3, record the O2 concentration.

Figure A.4 [EN] and D.4 [ISO] — Side view of instrumentation placement for generator minimum height/maximum area coverage and maximum height/maximum area coverage test

5.1.15.9 Fuel specification

5.1.15.10 Test pans

The test pans are to be cylindrical (80 ± 5) mm in diameter and at least 100 mm high made of mild or stainless steel with a thickness of 5 mm to 6 mm.

5.1.15.11 n-Heptane

The catalyst used for the (pre) burning purpose shall be a commercial grade n-Heptane

Commercial grade n-Heptane criteria		
Part	**Specific part**	**Remark / number**
Distillation	Initial boiling point	90 °C minimum

	Dry point	100 °C maximum
Density	at 15,6 °C	700 ± 50 kg/m3
MSDS	CAS #	142-82-5
	EINECS #	205-563-8

5.1.15.12 Fire configuration and placement

The test pans may contain either n-heptane or n-heptane and water. If they are to contain n-heptane and water, the n-heptane is to be at least 50 mm deep. The level of n-heptane in the pans shall be at least 50 mm below the top of the can.

The test pans are to be placed within 50 mm of the corners of the test enclosure and in addition directly behind the baffle (see Figures A.1/D.1 and A.1/D.2), and located vertically within 300 mm of the top or bottom of the enclosure, or both top and bottom if the enclosure permits such placement.

5.1.15.13 Test procedure

5.1.15.14 General

Prior to commencing tests, the composition of the extinguishing nitrogen shall be analyzed.

5.1.15.15 Operation

The heptane filled test pans are to be ignited and allowed to burn for 30 s with the closable openings above in the open position.

After 30 s all openings are to be closed and the extinguishing system is to be manually actuated. At the time of actuation of the system, the amount of oxygen within the enclosure shall not be more than 0,5 vol% lower than the normal atmospheric oxygen concentration. During the test, the oxygen concentration shall not change more than 1,5 vol% due to fire products. This change shall be determined by comparing the oxygen concentration measured in the cold discharge test with the measured oxygen concentration in this test (averaged over the three sensors).

After the required pre-burn period, record the following data for each test:

- The discharge time of extinguishant, in seconds;
- the time required to achieve extinguishment, in seconds. This time shall be determined by visual observation, thermocouples readings or other suitable means.

5.1.15.16 Fail / Pass criteria

Determination of distribution performance of the generator:
Using the extinguishing density for n-heptane, determined according to 5.1.18 all test pans shall be extinguished within 30 s after the end of agent discharge.

5.1.16 Maximum height test

5.1.16.1 Traceability

EN 15276-1	**ISO 15779**
Equals A.5.2	Equals D.5.2

NOTE: Configuration of test environment according [EN] and [ISO] ;
NOTE: Test facility described requirements for volume; parameter "C" [EN] and "Rmax" [ISO] are the same. [ISO] is used.
NOTE: "2) The distance c (see Figures A.1/D.1 and A.2/D.2) shall be equal to maximum coverage distance (Rmax) specified by manufacturer." Is a measure from the previous version of the standard. In the current drawings there is no distance "C".
NOTE: The extinguishing density for n-heptane, determined according to 3.3.5 shall be used

5.1.16.2 Test Facility Construction

The test enclosure shall meet the following requirements:

a) The area (a × b) and height (H) of the enclosure (see Figure A.1/D.1) shall correspond to the maximum area coverage and maximum height specified by the manufacturer for a specific nitrogen generator unit size.

b) Test room volume shall be determined from the result of heptane fire test (see 5.1.18)

- $V_{test} = M / (0.769 \cdot R_{max}) [m^3]$ (F.3)

  M is the generator's unit mass in grams

  R_{max} is the design factor, in grams per cubic meter

c) Area sides a and b shall be calculated to fulfill following requirements:

- $a \times b = V_{test} / H$ (F.4)

d) Means of pressure relief shall be provided;

e) Closeable openings shall be provided directly above the test pans to allow for venting prior to system actuation;

f) One baffle is to be installed between the floor and ceiling with the height of the room. It is to be installed halfway between the discharge outlet location and the walls of the enclosure (see Figure A.1/D.1 for center mounting generator and Figure A.2/D.2 for side mounting generator). The baffle is to be perpendicular to the direction of nozzle discharge, and be 20% of the length of the short wall of the enclosure.

5.1.16.3 Instrumentation

Instrumentation of the enclosure is as described in 5.1.15.3

5.1.16.4 Fuel specification

5.1.16.5 Test pans

Specification of test pans is as described in 5.1.15.10

5.1.16.6 n-Heptane

The n-heptane is commercial grade as specified in 5.1.15.11.

5.1.16.7 Fire construction and placement

The test can filling requirements and placement within the enclosure are as described in 5.1.15.12.

5.1.16.8 Test procedure

5.1.16.9 General

Prior to commencing tests the composition of the extinguishing nitrogen shall be analyzed.

5.1.16.10 Operation

The heptane filled test pans are to be ignited and allowed to burn for 30 s with the closable openings above in the open position.

After 30 s all openings are to be closed and the extinguishing system is to be manually actuated. At the time of actuation of the system, the amount of oxygen within the enclosure shall not be more than 0,5 vol% lower than the normal atmospheric oxygen concentration. During the test, the oxygen concentration shall not change more than 1,5 vol% due to fire products. This change shall be determined by comparing the oxygen concentration measured in the cold discharge test with the measured oxygen concentration in this test (averaged over the three sensors).

After the required pre-burn period, record the following data for each test:

- The discharge time of extinguishant, in seconds;
- the time required to achieve extinguishment, in seconds. This time shall be determined by visual observation, thermocouples readings or other suitable means.

5.1.16.11 Fail / Pass criteria

Determination of distribution performance of the generator:
Using the extinguishing density for n-heptane, determined according to 5.1.18 all test pans shall be extinguished within 30 s after the end of agent discharge.

5.1.17 Wood crib test, reduced dimensions

5.1.17.1 Traceability

EN 15276-1	ISO 15779	EN 15004-1
Equals A.6.1	Covers/partly D.6.1	Covers C.6.1

NOTE: [BRL] 2.3 is referring as "should" to a total pre-burn time of 4 minutes. The pre-burn time of 4 [BRL] and 6 minutes [ISO] , is discontinued in [EN], [EN] 2 minutes pre-burn as described is used within this testcase.
Note: Sampling and storage of data according EN15004-1; C.6.1.1.2.1

NOTE: The Wood crib itself has been reduced in size to meet the reduced dimensions of the test enclosure.

5.1.17.2 Test facility

5.1.17.3 Construction

The test enclosure shall meet the following requirements:

a) The test enclosure shall have a volume of ≥33 m^3. The height shall be no less than 3 m. The floor dimensions shall be no less than 3 m;

b) a means of pressure relief shall be provided to limit the pressure change with a cold discharge to ± 300 Pa.;

c) The temperature in the test enclosure shall be (20 ± 5) °C at the beginning of each test and there shall be enough time between the tests so that the enclosure can adapt to this temperature.

5.1.17.4 Instrumentation

Sampling and storage of data from the sensors described below shall occur at a rate of at least 1 Hz.

5.1.17.5 Oxygen concentrations

The oxygen level shall be measured by a calibrated oxygen analyzer capable of measuring the percentage oxygen to within at least one decimal place (0,1%) or better. The sensing equipment shall be capable of continuously monitoring and recording the oxygen level inside the enclosure throughout the duration of the test. The accuracy of the measuring devices shall not be influenced by any of the fire products.

At least three sensors shall be located within the enclosure (Figures A.5/D.5 and A.6/D.6). One sensor shall be located at the equivalent height of the top of the test object from the floor, 0,6 m to 1 m away from the test object. The other two sensors shall be located at 0,1 × H and 0,9 × H (with H = height of the enclosure (see Figures A.5/D.5 and A.6/D.6).

5.1.17.6 Discharge pressure

The pressure built up in the test enclosure during system discharge shall be measured and recorded by a pressure transducer.

5.1.17.7 Enclosure temperature

Temperature sensors shall be located centered 100 mm above the test object and 0,9 × H (H = room height), and a third sensor at the equivalent height of the top of the test object from the floor, horizontally 0,6 m to 1 m away from the test object (see Figures A.5/D.5 and A.6/D.6).

The temperature in the test enclosure shall be 20 °C ± 5 °C at the beginning of each test.

NOTE: It is recommended to use K type thermocouples (Ni-CrNi), diameter 1 mm.

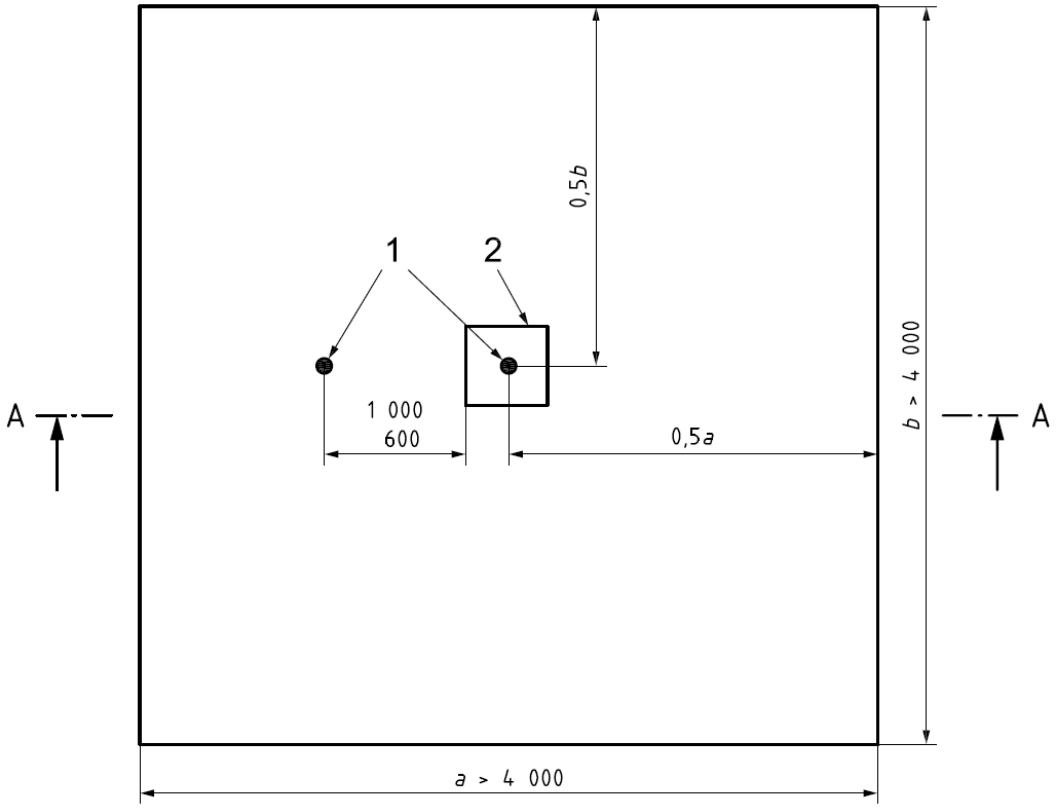
5.1.17.8 Nitrogen temperature and discharge times

A thermocouple shall be placed just outside the discharge outlet of the nitrogen generator to record nitrogen temperature at the outlet as well as commencement and end of nitrogen discharge. Additional thermocouples may be placed at the minimum thermal clearance from the discharge outlet as specified by the manufacturer for each unit size of the nitrogen generators.

NOTE: It is recommended to use K type thermocouples (Ni-CrNi), diameter 1 mm.

5.1.17.9 Flame out times

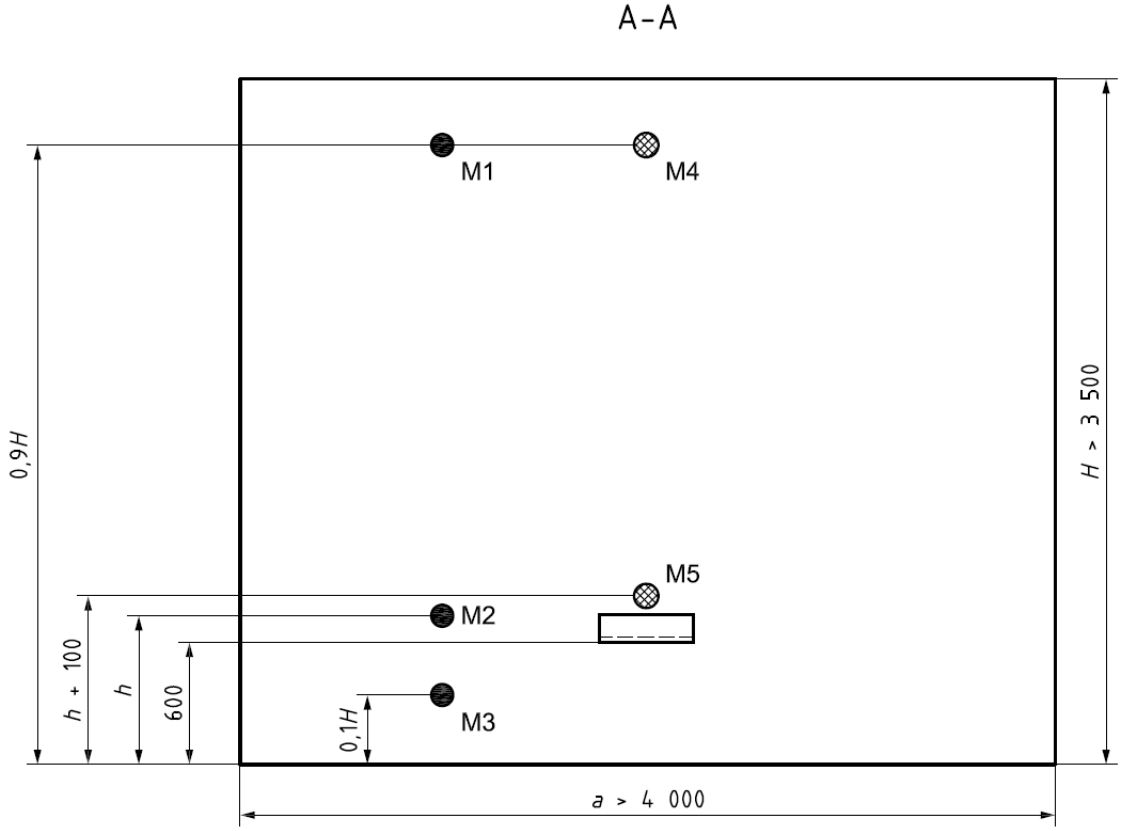
Cameras, e.g. infrared-cameras, or an alternative means of directly viewing the fire can be provided as an aid to determining flame out times. Thermocouples may be located 30 mm above and inside the wood crib in order to aid in determining flame out time (see Figures A.5/D.5 and A.6/D.6).



Dimensions in mm

Key
1 measuring point
2 test object

Figure A.5 [EN] and D.5 [ISO]— Plan view of instrumentation placement for the extinguishing concentration test



Dimensions in mm

Key

M1 At measuring point 1, record the O2 concentration.
M2 At measuring point 2, record the O2 concentration and temperature.
M3 At measuring point 3, record the O2 concentration.
M4 At measuring point 4, record the temperature.
M5 At measuring point 5, record the temperature.

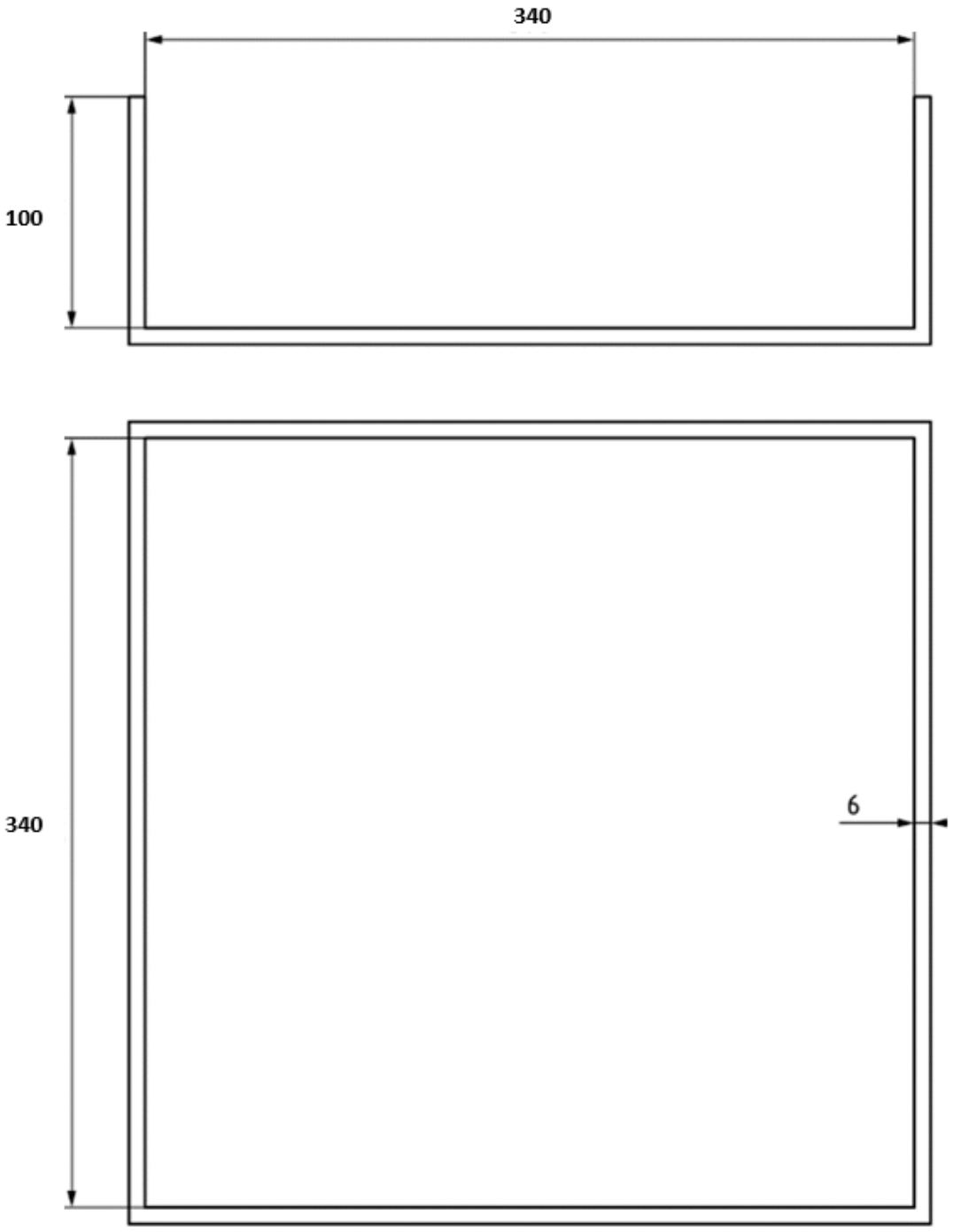
Figure A.6 [EN] and D.6 [ISO] – Side view of instrumentation placement for the extinguishing concentration test

5.1.17.10 Fuel specification

5.1.17.11 Crib igniter fuel, square steel pan

Ignition of the crib is achieved by burning approx. 0.35 L of heptane (specified in 5.1.15.11) on a 6 L layer of water in a square steel pan 0,12 m^2 in area, 100 mm in height and with a wall thickness of 6 mm (see Figure A.7/D.7).

NOTE: The dimension of the square steel pan is reduced for the N-Heptane test and to fit the wood crib which is also reduced in size. The burning time of the heptane must be approx. 2 minutes. If needed the quantity of heptane shall be adjusted to achieve the required pre burning time.



Dimensions in millimeters

Figure A.7 [EN] and D.7 [ISO] — Pan geometry for Wood crib and n-Heptane pan fire test

5.1.17.12 *Fire configuration and placement*

The wood crib is to consist of five layers of six, approximately 25 mm × 25 mm by (250 ± 50) mm long, kiln spruce or fir lumber having a moisture content between 9 % and 13 %. Place the alternate layers of wood members at right angles to one another. Evenly space the individual wood members in each layer forming a square determined by the specified length of the wood members. Staple or nail together the wood members forming the outside edges of the crib.

The crib shall be pre-burned inside the enclosure on a stand supporting the crib 300 mm above the pan holding the igniter fuel (specified in 5.1.15.11).

5.1.17.13 Test procedure

5.1.17.14 General

Prior to commencing tests the composition of the extinguishing nitrogen shall be analyzed. Record the mass and the moisture of the crib prior to the test.

5.1.17.15 Operation (different than described in standard)

Centre the crib with the bottom of the crib approximately 300 mm above the top of the pan on a test stand constructed so as to allow for the bottom of the crib to be exposed to the atmosphere. The pre-burning shall take place inside the enclosure.

The test enclosure shall be equipped with adequate means of ventilation above the wood crib which is closable on demand within 5 seconds.

Ignite the n-heptane and allow the crib to burn freely. The 0.35 L of n-heptane will provide a burn time of approximately two (2) minutes [EN].

Just prior to the end of the pre-burn period seal the enclosure and actuate the system. The time required to the actuation of the system discharge shall not exceed 15 s.

At the time of actuation of the system, the amount of oxygen within the enclosure at the level of the crib shall not be more than 0,5 vol% lower than the normal atmospheric oxygen concentration. During the test, the oxygen concentration shall not change more than 1,5 vol% due to fire products. This change shall be determined by comparing the oxygen concentration measured in the cold discharge test with the oxygen concentration measured in this fire test (averaged values).

From the end of system discharge, the enclosure is to remain sealed for a total of 10 min. After the soak period, remove the crib from the enclosure and observe to determine that sufficient fuel remains to sustain combustion and for signs of re-ignition.

The following shall be recorded:

- presence and location of burning embers;
- whether or not the glowing embers or crib re-ignites;
- mass of the crib after the test.

If necessary, amend the nitrogen extinguishing factor and repeat the experimental program until 3 successive, successful extinguishments are achieved.

After the required pre-burn period, record the following data for each test:

a) The discharge time of extinguishant, in seconds;
b) The time required to achieve extinguishment, in seconds. This time shall be determined by visual observation, thermocouples readings or other suitable means;
c) The soaking time (time from the end of system discharge until the opening of the test enclosure);
d) Recording the temperature profile of the wood crib, using the infrared camera, is recommended.

5.1.17.16 Fail / Pass criteria

Determination of extinguishant design application density:
The laboratory extinguishing application density is that which achieves satisfactory extinguishment of the fire over three successive tests (no re-ignition or existence of burning

embers after 10 min after end of discharge). The design application density is the laboratory extinguishing factor multiplied by an appropriate 'safety factor'. (1.3 [EN])

Extinguishing density shall be calculated dividing the effective mass of nitrogen compound installed by the test room volume.

5.1.18 N-Heptane pan test, reduced dimensions

5.1.18.1 Traceability

EN 15276-1	ISO 15779	EN 15004-1
Equals A.6.2	Equals D.6.2	Covers C.6.2

5.1.18.2 Test facility

5.1.18.3 Construction
Construction of the enclosure is as described in 5.1.20.2

5.1.18.4 Instrumentation
Instrumentation of the enclosure is as described in 5.1.20.3

5.1.18.5 Fuel specification

5.1.18.6 n-Heptane
The n-heptane is commercial grade as specified in 5.1.18.11

5.1.18.7 Fire configuration and placement
The fire will be a square steel pan of 0,12 m^2, 100 mm high with a wall thickness of 5 or 6 mm as specified in 5.1.20.10.
The test pan is to contain approx. 6 l of n-heptane. The resulting n-heptane surface is then approx. 50 mm below the top of the pan.
The steel pan shall be located in the center of the test enclosure with the bottom 600 mm above the floor of the test enclosure.

5.1.18.8 Test procedure

5.1.18.9 General
Prior to commencing tests the composition of the extinguishing nitrogen shall be analyzed.

The heptane is to be ignited and allowed to burn for 30 s.
The heptane in the test cans shall be ignited at the same time or before the main pan. The first test can shall be ignited at a maximum of 60 s before the main pan.
After 30 s all openings are to be closed and the extinguishing system is to be manually actuated. At the time of actuation of the system, the amount of oxygen within the enclosure shall not be more than 0,5 vol% lower than the normal atmospheric oxygen concentration. During the test, the oxygen concentration shall not change more than 1,5 vol% due to fire products. This change shall be determined by comparing the oxygen concentration measured in the cold discharge test with the oxygen concentration measured in this fire test (averaged values).
The test is only positive if the main test object is extinguished later than the test cans are extinguished or at a maximum of 10 s earlier.

NOTE: See 5.1.17.3 for superseding text

If necessary, amend the extinguishant extinguishing factor and repeat the experimental program until three successive, successful extinguishments are achieved.

Results are to be recorded as specified in 5.1.17.15 with the exception of d).

5.1.18.10 Fail / Pass criteria

Determination of extinguishant design density:
The laboratory extinguishing density is that which achieves satisfactory extinguishment of the fire over three successive tests (no flaming 30 s after the end of extinguishant discharge). The design density is the laboratory extinguishing density multiplied by an appropriate safety factor (1.3 [EN]).

Extinguishing density shall be calculated dividing the effective mass of nitrogen compound installed by the test room volume.

5.1.19 Polymeric sheet fire test, reduced dimensions (room only)

5.1.19.1 Traceability

EN 15276-1	ISO 15779	EN 15004-1
Equals A.6.3	Equals D.6.3	Covers C.6.3

5.1.19.2 Test facility

5.1.19.3 Construction

Construction of the enclosure is as described in 5.1.18.3

5.1.19.4 Instrumentation

Instrumentation of the enclosure is as described in 5.1.18.4

Fuel specification

5.1.19.5 Igniter fuel

The ignition source is a heptane pan (constructed of 2 mm thick mild or stainless steel) with inside to inside 51 mm × 112 mm and 21 mm deep centered 12 mm below the bottom of the plastic sheets of polymeric fuel (see Figure A.8/D.8). The 51 mm side of the pan is orientated parallel to the sheets of polymeric fuel so that all 4 sheets are above the ignition source. The pan is filled with 10 ml of heptane (specified in 5.1.18.11) on a water base of 40 ml.

5.1.19.6 Polymeric fuel

Tests are to be conducted with three plastic fuels:

- Polymethyl methacrylate (PMMA);
- Polypropylene (PP),

Plastic properties are given in Table A.2 [EN] and D.2 [ISO]

Plastic properties 25 kW/m2 Exposure in Cone Calorimeter ISO 5660-1 Cone Calorimeter Test								
Table A.2 [EN] and Table D.2 [ISO]								
Fuel	Color	Density	Ignition Time		180 s average Heat Release Rate		effective Heat of Combustion	
		g/cm^3	s	Tolerance	kW/M^2	Tolerance	MJ/kg	Tolerance
PMMA	Black	1.19	77	30%	286	25%	23.3	25%
Polypropylene	Natural (white)	0.905	91	30%	225	25%	39.6	25%

5.1.19.7 Polymeric fuel array

The polymeric fuel array shall consist of 4 sheets of polymer, which are cut to 405 mm ± 5 mm high by 200 mm ± 5mm wide. The thickness of all sheets shall be 10 ± 1 mm.
A combination of sheets during testing is allowed.
In case of a combination, the sheets shall be placed in pairs.

Sheets are spaced and located as per Figure A.8/D.8. The bottom of the fuel array is located 203 mm from the floor. The fuel sheets shall be mechanically fixed at the required spacing. The sheets of plastic shall not significantly bend during the test.

The fuel array shall be located centrally within the enclosure.

5.1.19.8 Fuel shield

A fuel shield consisting of a metal frame with sheet metal on the top and two sides shall be provided around the fuel array as indicated in Figure D.8. The fuel shield is 380 mm wide, 850 mm high and 610 mm deep. The 610 mm (wide) × 850 mm (high) sides and the 610 mm × 380 mm top are metal sheet. The two remaining sides and bottom are open.

The metal sheet shall be aluminum with a wall thickness of 2 mm to 3 mm.

The fuel array is oriented in the fuel shield such that the 200 mm dimensions of the fuel array is parallel to the 610 mm side of the fuel shield.

5.1.19.9 External baffles

External baffles are constructed as shown in Figure D 10 and are located around the exterior of the fuel shield. The baffles are placed 90 mm above the floor. The top baffle is rotated 45° with respect to the bottom baffle.

5.1.19.10 Test procedure

5.1.19.11 General

Prior to commencing tests the composition of the extinguishing nitrogen shall be analyzed.
Record the mass of the plastic sheets prior to the test.

5.1.19.12 Operation

The n-heptane is ignited and allowed to burn completely.
210 s after ignition of the n-heptane, all openings are to be closed and the extinguishing system is to be manually actuated.

At the time of actuation of the system, the amount of oxygen within the enclosure at the level of the fuel shall not be more than 0,5 vol% lower than the normal atmospheric oxygen concentration. During the test, the oxygen concentration shall not change more than 1,5 vol% due to fire products. This change shall be determined by comparing the oxygen concentration measured in the cold discharge test with the oxygen concentration measured in this fire test (averaged values).

The enclosure is to remain sealed for a total of 10 min from end of discharge. After the soak period, ventilate the enclosure and observe to determine that sufficient fuel remains to sustain combustion and for signs of reignition. The following shall be recorded:

- presence and location of burning fuel;
- whether or not the fire re-ignites; and
- mass of the fire structure after the test.

If necessary, amend the extinguishing factor and repeat the experimental program until three successive, successful extinguishments are achieved.

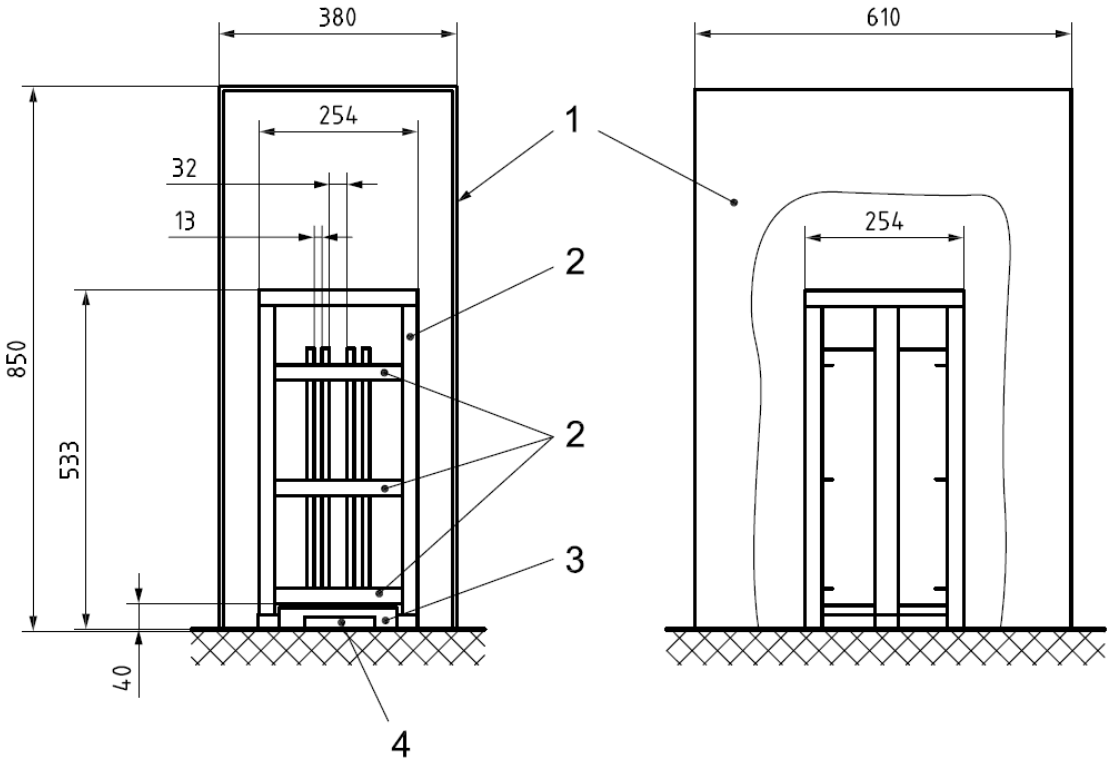
After the required pre-burn period, record the following data for each test:

- The discharge time of extinguishant, in seconds.
- The time required to achieve extinguishment, in seconds. This time shall be determined by visual observation, thermocouples readings or other suitable means.
- The soaking time (time from the end of system discharge until the opening of the test enclosure).

5.1.19.13 Fail / Pass criteria

Determination of the extinguishant design density:
The laboratory extinguishing density for each fuel or combined fuels (if applicable) is that which achieves satisfactory extinguishment of the fire over three successive tests (Flame knock down within 60 s, and no re-ignition after 10 minutes, all from end of discharge).

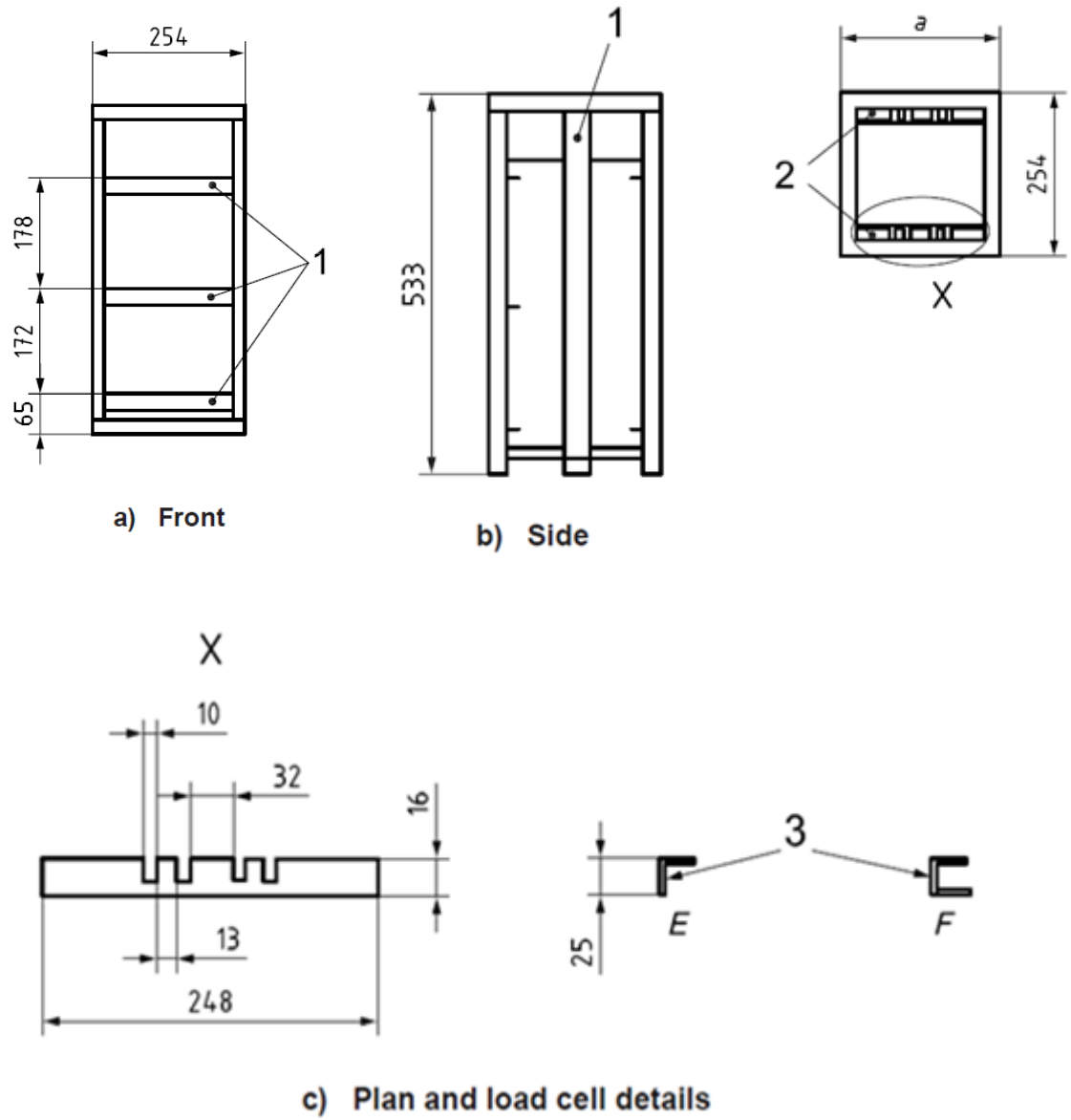
The design application density is the or the highest of the laboratory extinguishing factors for the two fuels (see 5.1.22.6) multiplied by an appropriate safety factor (1.3 [EN]). Extinguishing density shall be calculated dividing the effective mass of nitrogen compound installed by the test room volume.



Dimensions in millimeters

Key
1 channel metal frame covered with metal sheeting on top and two sides
2 metal angle frame
3 fuel guide bars
4 load cell

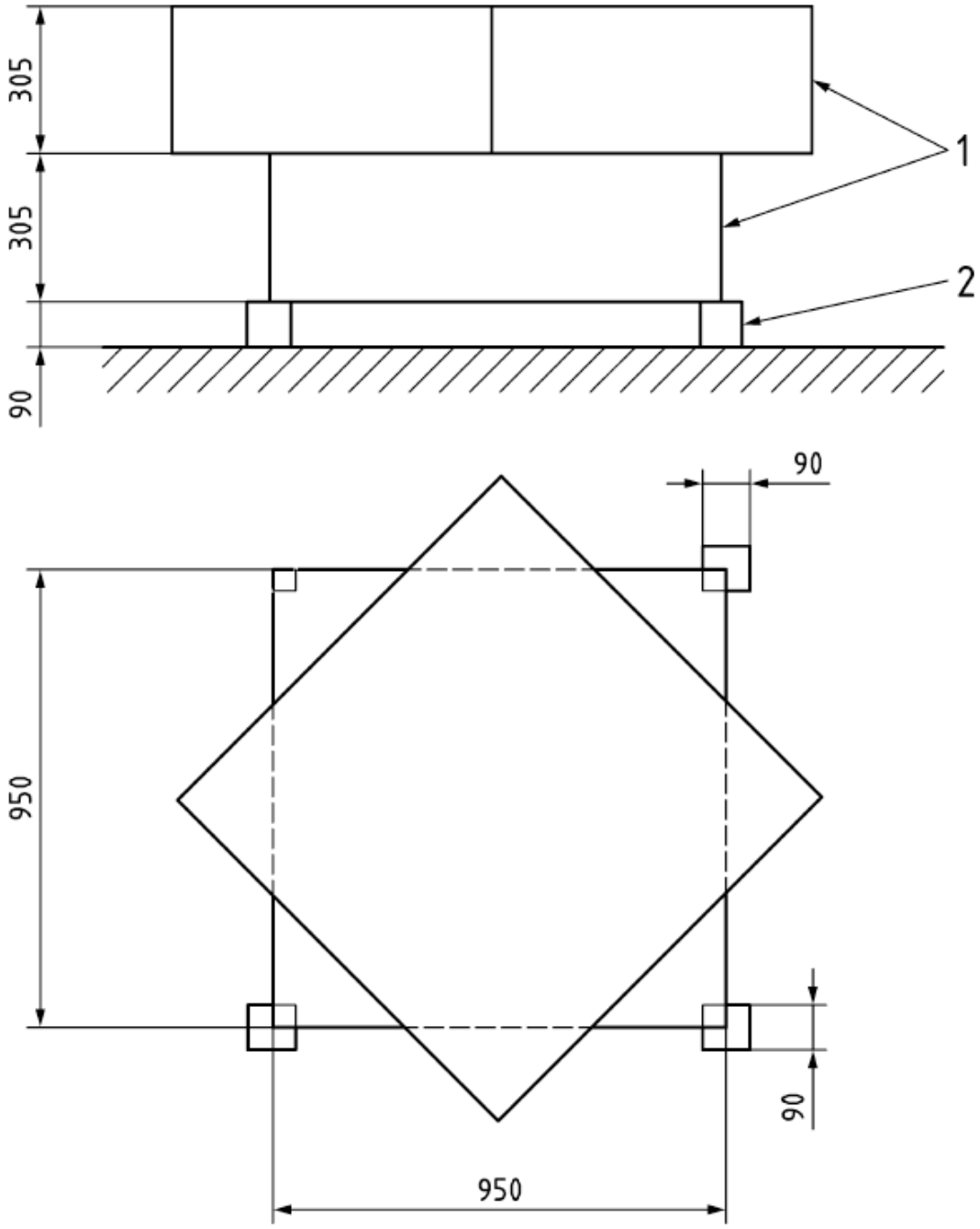
Figure A.8 [EN] and D.8 [ISO]— Polymeric sheet fire



Dimensions in millimeters

Key
a) front
b) side
c) plan and load cell details
1 metal angle frame
2 load cell
3 fuel guide bars

Figure A.9 [EN] and D.9 [ISO]— Support rack for plastic sheets



Dimensions in millimeters

Key
1 polycarbonate or metal baffles
2 cinder block

Figure A.10 [EN] and D.10 [ISO] — Polymeric sheet fire baffle arrangement

5.1.20 Class A Compatible Wood Crib Test, reduced dimensions

5.1.20.1 Traceability

EN 15276-1	ISO 15779
Equals A.6.4	Equals D.6.4

5.1.20.2 Test facility

5.1.20.3 Construction

5.1.20.4 Fuel configuration

This Class A compatible fire test shall consist of two (2) wood cribs, each measuring 0.225 x 0.225 x 0.225 m. The crib is to consist of nine alternate layers of five trade size 2.5 cm by-2.5 cm kiln-dried spruce or fir lumber 0.225 m long. The alternate layers of lumber shall be placed at right angles to the adjacent layers. The individual wood members in each layer are to be evenly spaced along the length of the previous layer of wood members and fastened by staples or nails.

The wood cribs shall be preconditioned to have a moisture content of 9 and 13 percent by weight.

5.1.20.5 Fuel placement

One crib is to be placed behind a baffle installed between the floor and ceiling at the midpoint between the direction of discharge and a wall. The baffle is to be perpendicular to the direction of nozzle discharge, and be 20 percent of the length or width of the enclosure, whichever is applicable with respect to discharge location. The crib is to be placed on a stand and supported by four 5.1 cm bricks placed at each corner of the crib such that the bottom of the crib is 50mm above the floor. The crib shall have a 85 g mass of shredded newspaper placed under the crib in the center of the four bricks.

NOTE: For the requirement on shredded newspaper see DIN 66399; Level P-2 = ≤ 800 mm² particles or ≤ 6 mm wide strips of any length

One crib is to be placed on a stand in the center of the enclosure and supported by four 5.1 cm bricks placed at each corner of the crib such that the bottom of the crib is 50 mm above the floor. The crib shall have a 85 g mass of shredded newspaper placed under the crib in the center of the four bricks.

NOTE: For the requirement on shredded newspaper see DIN 66399; Level P-2 = ≤ 800 mm² particles or ≤ 6 mm wide strips of any length

5.1.20.6 Fuel shield

A fuel shield consisting of a metal frame with sheet steel on the top shall be provided around the crib located in the center of the enclosure as indicated in Figure A.11/D.11 and A.12/D.12. The fuel shield is to be 76 cm wide, 82.5 cm high and 76 cm deep. The 76 cm by 76 cm top is to be sheet steel. The remaining four sides and the bottom are to be open.

Two external baffles measuring 0.95 m square and 30 – 30.5 cm tall are to be located around the exterior of the fuel shield as shown in Figure A.11/D.11 and A.12/D.12. The baffles are to be placed 9 cm above the floor. The lower baffle is to be oriented with its sides parallel to the fuel shield and the top baffle is to be rotated 45 degrees with respect to the bottom baffle.

A baffle is to be installed between the floor and ceiling at the midpoint between the center of the enclosure and a wall parallel to the baffle width. The floor to ceiling baffle width is to be 20 percent of the length of the walls parallel to the baffle as indicated in Figure A.11/D.11 and A.12/D.12. .

The two cribs are to be placed on the floor supported by four 5.1 cm high bricks, one at each corner of the crib as indicated in Figure A.11/D.11 and A.12/D.12. One of the cribs is to be centered between the two walls perpendicular to the floor to ceiling baffle with two sides of the

crib parallel to the floor to ceiling baffle and the center of the crib located 45 cm behind the floor to ceiling baffle relative to the center of the enclosure. The other crib is to be centered in the enclosure.

5.1.20.7 Test procedure

5.1.20.8 General

Prior to commencing tests the composition of the extinguishing nitrogen shall be analyzed. Record the mass and the moisture of the cribs prior to the test.

5.1.20.9 Operation

- Nitrogen generators placement:
  The nitrogen generator(s) shall be installed under the maximum design limitations and most severe installation instructions according to the methods specified in the manufacturer's design and installation instructions.
- For the Class A Wood Crib Fire Tests, the nitrogen generator(s) shall be installed on the side of the enclosure opposite the crib located behind the floor to ceiling baffle.

  The nitrogen generator(s) are to be conditioned to 21±2.8°C

- Fuel ignition
  Each crib shall have a 85 g mass of shredded newspaper placed under the crib in the center of the four bricks, 177 ml of denatured ethyl alcohol is to be poured over each crib and paper, and then ignited.
  NOTE: For the requirement on shredded newspaper see DIN 66399; Level P-2 = ≤ 800 mm² particles or ≤ 6 mm wide strips of any length

- Pre-burn
  After ignition, each crib is to be allowed to burn for 2 minutes. The percent of oxygen is to be measured by a calibrated analyzer at locations, which are at the same height as the wood cribs and centered from the edge of the crib to the near wall. Two additional measurements are to be made at 0.1 H and 0.9 H, with H being the height of the enclosure. Just prior to discharging agent into the enclosure, the vents, except for the pressure relief, are to be quickly closed and the nitrogen generator system is to be manually actuated. At the time of system discharge, the percent oxygen within the enclosure at the level of the cribs is to be within 0.5 percent of the normal oxygen level at atmospheric conditions.
- Nitrogen generators actuation
  Except for the pressure relief, the vents are to be closed and the system is to be actuated. At the time of actuation, the percent oxygen within the enclosure at the level of the crib shall be within 0.5 percent of the normal oxygen level at atmospheric conditions. The percent of oxygen is to be measured by a calibrated analyzer at a location, which is at the same height as the bottom of the wood crib and centered from the edge of the crib to the wall. Two additional measurements are to be made at 0.1 H and 0.9 H, with H being the height of the enclosure.

The following shall be recorded:

- presence and location of burning embers;
- whether or not the glowing embers or crib re-ignites;
- mass of the crib after the test.

If necessary, amend the nitrogen extinguishing factor and repeat the experimental program until 3 successive, successful extinguishments are achieved.

After the required pre-burn period, record the following data for each test:

- The discharge time of extinguishant, in seconds;

- The time required to achieve extinguishment, in seconds. This time shall be determined by visual observation, thermocouples readings or other suitable means;
- The soaking time (time from the end of system discharge until the opening of the test enclosure);
- Recording the temperature profile of the wood crib, using the infrared camera, is recommended.

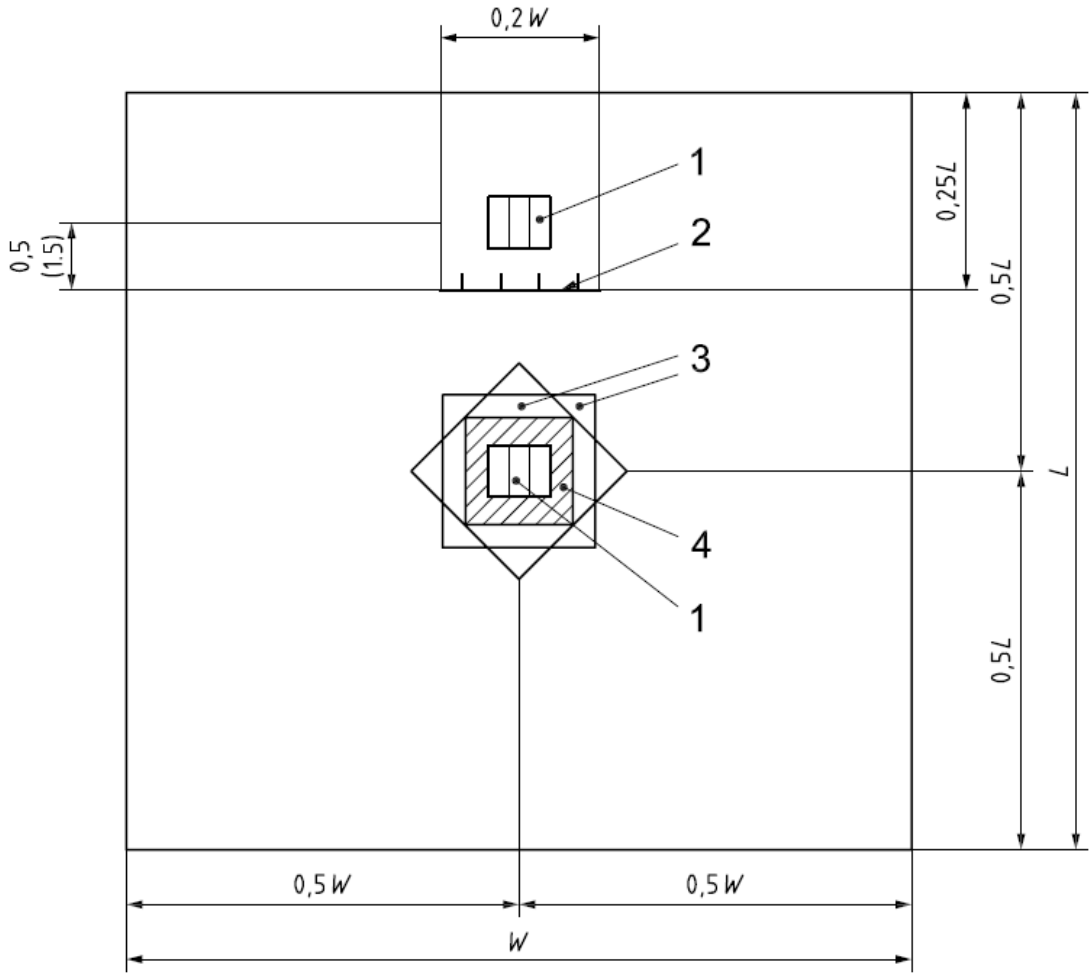
5.1.20.10 Fail / Pass criteria

After the start of system discharge, observations shall be made for crib extinguishment. The enclosure is to remain sealed for a total of 600 seconds after the end of discharge. After the 600 second soak period, the cribs are to be quickly removed from the enclosure, observed to determine whether fuel remains to sustain combustion and for signs of re-ignition.

5.1.20.11 Determination of the extinguishant application density

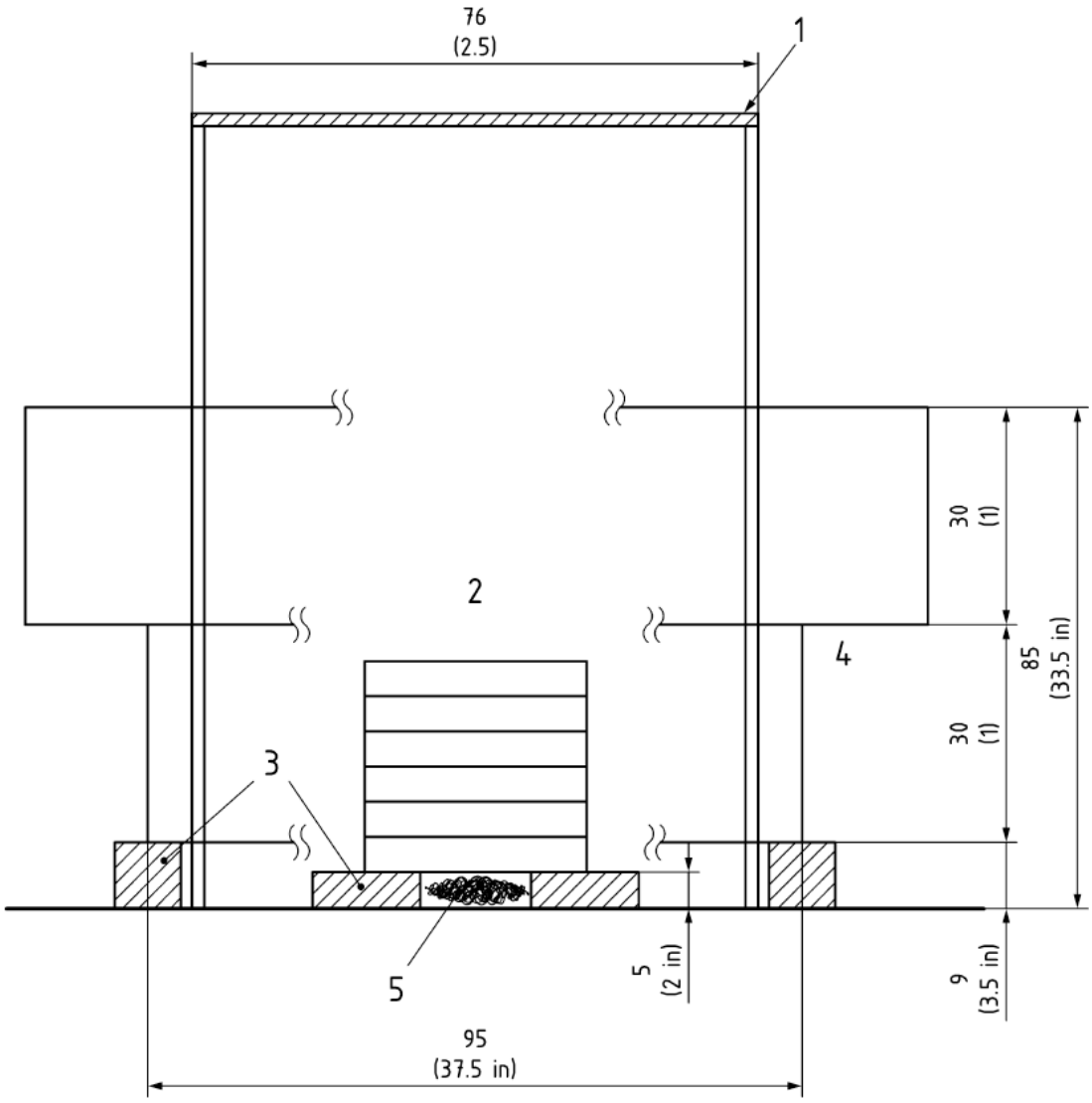
The extinguishing application density is that which achieves satisfactory extinguishment of the fire over three successive tests (no re-ignition or existence of burning embers after 10 min after end of discharge). The design application density is the laboratory extinguishing factor multiplied by an appropriate 'safety factor'. (1.3 [EN])

The extinguishing density shall be calculated by dividing the total generator's effective mass of extinguishant installed by the test room volume.
The extinguishing density for each test shall be 76,92 % of the intended end use design application density or densities specified in the manufacturer's design and installation instructions.



Key
1 wood crib location
2 floor-to-ceiling baffle
3 polycarbonate baffles
4 fuel shield

Figure A.11 [EN] and D.11 [ISO] — Wood crib locations - plan view



Dimensions in centimeters and (inches [in] or feet)

Key
1 table baffle
2 wood crib (text deleted)
3 brick
4 polycarbonate baffles
5 shredded newspaper

Figure A.12 [EN] and D.12 [ISO] — Centre wood crib detail - elevation view

5.1.21 Composite wood fire test

5.1.21.1 Traceability

EN 15276-1	ISO 15779
Discontinued	-

NOTE: no further text regarding this test in this report.

5.1.22 Test of the determination of the maximum leakage area/volume ratio

5.1.22.1 Traceability

EN 15276-1	ISO 15779
Equals A.7	Covers D.7

5.1.22.2 Test facility

5.1.22.3 Construction

Construction of the enclosure is as described in 5.1.17.3.

Two identical open areas have also to be provided, one on the ceiling of the enclosure and the other on the bottom center opposite on the short side of the enclosure. The shape shall be square or rectangular with a base: height maximum ratio of 2:1. The sum of the two areas will be taken as the leakage area.

5.1.22.4 Instrumentation

Instrumentation of the enclosure is as described in 5.1.17.4. Cameras or alternative method described for flame out time in 5.1.17.9 shall be used to determine the appearance of flames. All cans described shall be monitored.

5.1.22.5 Fuel specification

5.1.22.6 n-Heptane

The n-heptane is commercial grade as specified in 5.1.15.11

5.1.22.7 Fire configuration and placement

Test cans will be as described in 5.1.15.10
The test pans may contain either n-heptane or n-heptane and water. If they are to contain n-heptane and water, the n-heptane is to be at least 50 mm deep. The level of n-heptane in the pans shall be at least 50 mm below the top of the can.

Two sets of three test cans are to be placed within 500 mm of two walls. One set will be located opposite to the other and for each set the cans will be located at 10%, 50% and 90% of the height of the enclosure.

Means for remote ignition shall be provided for each of the test cans.

5.1.22.8 Test procedure

An engineered or pre-engineered nitrogen extinguishing formulation shall be able to keep extinguishing conditions for the hold time when tested in accordance with this test method under the maximum design limitations and most severe installation instructions.

The test is based on the ability of the extinguishing unit to prevent ignition of heptane cans distributed through the enclosure.

5.1.22.9 General

Prior to commencing tests the composition of the extinguishing nitrogen shall be analyzed.

5.1.22.10 Operation

The extinguishing system is to be manually actuated.

Prior to the expected hold time all the remote ignitors will begin to actuate in 60 seconds intervals.
For accuracy it is advised to use shorter intervals (e.g. 10 or 15 seconds).

Record the following data for each test:

- The discharge time of extinguishant, in seconds;
- The time at which each actuation of the ignitors is produced, in seconds;
- The time required to the first can to ignite, in seconds. This time shall be determined by visual observation, thermocouples readings or other suitable means;

5.1.22.11 Determination of hold time:

The hold time for the test is the time when the last activation of all the igniters did not produce ignition of any of the cans. The test is to be repeated three times. The maximum hold time applicable to the specified leakage area to volume ratio is the shortest hold time obtained from the three tests.

If the hold time obtained is less than 10 min, the test shall be repeated using a smaller leakage area.
Different leakage area values can be tested to provide different hold times for different leakage area to volume ratios.
The parameter(s) obtained shall be given as m2 leakage area/m3 volume protected for the specified hold time.

- First test: Based on Maximum Leakage Area/Volume ratio for hold time of 10 min.
- Second Test (Optional): Based on 0,1 % Leakage Area/Volume ration for hold time of 30 min.

Definition of re-ignition: Test Cans constantly burning for more than 1 min.

5.1.22.12 Fail / Pass criteria

Fail test criteria for the First Test: Re-ignition before or at 9 min.
Fail test criteria for the Second Test: Re-ignition before or at 29 min.

Definition of re-ignition: Test Cans constantly burning for more than 1 min.

5.1.23 Nitrogen Generator Explosive Atmosphere Test

5.1.23.1 Traceability

EN 15276-1	ISO 15779
Discontinued	-

NOTE: no further text regarding this test in this report.
NOTE: [EN] assumes that an explosive atmosphere is a special situation and handled accordingly.

5.1.24 EN2, Class C, fires gas

5.1.24.1 Traceability

EN 15276-1	ISO 15779
Equals A.6.5	-

5.1.24.2 Test objective

The performance requirement for Class C fires of the fire extinguishing agent is determined as following: The extinguishing system shall extinguish the test object Class C according to EN2 as described in this test.

5.1.24.3 Test method

A triangular diffusion burner similar to a burner as used for SBI testing (EN13283) is the test object.
The triangular burner measurements shall be:

- Sides of 250 mm and
- Height of 50-60 mm.

The burner will be filled or fitted, from bottom to top, with:

- A centrally positioned inlet,
- one layer of mesh (2-3 mm),
- at least two layers of gravel (8 – 16 mm),
- at least two thermocouples and
- A thermal cut-out system which interrupts the flow of gas.

The mesh must be able to support the gravel and ensure an evenly distribution of the entering propane though the centrally positioned inlet in the bottom of the burner.
A controlled volume of 2 – 2.5 kg/h propane gas is blown through the burner.
The use of a commercially available propane gas cylinder and appropriate low (30 – 50 mbar) or high (1500 mbar) pressure regulator is allowed.
After activation the propane gas burner must burn with a diffusion flame and have a thermal power of 25-30 kW.
Note: If needed, adjust the amount of gravel, to obtain a evenly spread diffusion flame. In a diffusion flame, combustion takes place at the flame surface only, where the fuel meets oxygen in the right concentration - the interior of the flame contains unburnt fuel.

The total pre burning time shall be 2 minutes.

The test object to be extinguished shall be placed in the center of the test room at floor level. The nitrogen generators shall be installed in accordance with 5.1.17.1 ad 1

After the end of the activation of the fire extinguishing system the room shall remain closed for at least 10 minutes. During this period the gas burner shall be monitored for signs of active fire and signs of spontaneous activation at any given point of the burner, based on the temperature measurements directly above the burner.

The gas burner shall have a thermal cut-out which independently interrupts the flow of gas when the burner is extinguished.

Note that:

- An activation of the thermal cut-out does not automatically mean that the test is ended.

Erratic or turbulent behavior of the flames can cause an undesirable early activation of the thermal cut-out.
Only an activation of the thermal cut-out together with a visual or technical verification that there are no active flames means that the test is ended.

5.1.24.4 Fail / Pass criteria

The temperature after extinguishing shall be decisive and must be below 455 °C or 851 °F.
Visible fire is considered as a sign of (spontaneous) activation, but solely smoke is not.

- All signs of fire shall be described in the report;
- Moment of extinguishment shall be described in the report;
- Moment of a thermal cut-out activation shall be described in the report.
- After the period of 10 minutes, the burner shall be inspected visually for signs of active fire and then tested for correct activation and function without the presence of the fire extinguishing agent.

6 Factory Production Control Fire Protection Components by Kiwa

See TIC- scheme K21045.

7 Inspection of Fire Protection Systems by Kiwa

See TIC- scheme K21045.

8 Marking

8.1 General

See TIC scheme K21045.

8.2 Certification mark

See TIC scheme K21045.

8.2.1 Product / component marking by the manufactorer

For indications and markings see product standard:

EN 15276-1	ISO 15779
Covers 5.16	Covers Annex A

The products shall be marked with following indelible marks and indications:

- name of the product / Extinguishant trade name;
- manufacturer's or supplier's name or trade mark;
- some mark(s) or code(s) (e.g. serial number or batch code), by which, at least, the date or batch and place of manufacture (if several places of manufacture) can be identified by the manufacturer;
- mass of nitrogen forming compound;
- date of manufacture;
- temperature range;
- storage humidity range;
- service life;
- distances as specified in [EN] 5.11.3;
- fire classes according to EN 2;
- reference to the relevant version of operation and instruction manual.

For condensed nitrogen generators, installers shall attach a durable metallic tag to each nitrogen generator indicating the installation date, and the expiration date. Installation life (from installation to expiration date) for condensed nitrogen generators depends on the specific application and the installation environment (based on expected conditions of operation, e.g. temperature and humidity).

9 Requirements in respect of the quality system

See TIC scheme K21045.

10 Summary of tests and inspections

See TIC scheme K21045.

11 Agreements on the implementation of certification

See TIC scheme K21045.

12 Titles of standards

12.1 Public law rules

See TIC scheme K21045.

12.2 Standards / normative documents

See TIC scheme K21045.

Number	Title	Version*
EN15004-8	Fixed firefighting systems - Gas extinguishing systems - Part 8: Physical properties and system design of gas extinguishing systems for IG-100 extinguishant	2018

*) When no date of issue has been indicated, the latest version of the document is applicable.

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