Amendments to the "Rules for the Type Approval of Fixed Dry Chemical Powder Fire-Extinguishing Systems in Machinery Spaces"

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+971 2 6922333 +971 2 4454333 info@tasneef.ae 111155, Abu Dhabi, UAE

Chapter 1 – General Requirements For Approval

1 GENERAL

1.1 Premise

Fixed powder fire-extinguishing systems for use in machinery spaces, equivalent to conventional fixed fire-extinguishing systems required by Tasneef Rules, may be accepted on board if Tasneef type approved only.

...OMISSIS..

1 SCOPE

This test method is intended for evaluating the extinguishing effectiveness of fixed powder fire extinguishing systems for the protection of machinery spaces of category A.

This test method is applicable to systems using chemical powder as extinguishing medium.

The test program has two objectives:
(1) establishing the extinguishing effectiveness of a given agent, and
(2) establishing that the particular agent distribution system puts the agent into the enclosure in such a way as to fully flood the volume to achieve an extinguishing concentration at all points.

2 SAMPLING

The components to be tested are to be supplied by the Manufacturer together with design and installation criteria, operational instructions, drawings and technical data sufficient for the identification of the components.

3 METHOD OF TEST

3.1 Principle

This test procedure enables the determination of the effectiveness of the extinguishing systems against spray fires, pool fires and class A fires including polymeric materials fires.

3.2 Apparatus

3.2.1 Test Room

The test is to be performed in a test room ~~with~~ having a gross volume ~~equal~~ corresponding, as ~~much~~ far as ~~possible~~ practicable, to the maximum volume for which the fire extinguishing system approval is ~~expected~~ requested.

~~The tests are to be performed in a~~ In general, the test room ~~with a volume between~~ is to be not less than ~~35, 70 or 140~~ 20 m^3 in gross volume.~~,~~ Standard ISO containers 20' or 40'~~:~~ or combination of containers ~~with one side deprived~~ to increase the room volume may also be accepted. In the case of combination of containers, the final layout of the test room is to consist in a single open room, with no separations between one container module and the other. The test room is to be provided with a closable access door measuring approximately 4 m^2 in area.

Taking into consideration the previously mentioned over and under pressurization the release of an extinguishing medium may produce, suitable means (or procedures) to safely equilibrate the pressure, as well as dissipate the accumulated heat, prior to access again the test room, are to be provided.

Test room layouts other than those specified above may be accepted on a "case-by-case" basis.

3.2.2 Integrity of the test Enclosure

The test enclosure is to be nominally leaktight when doors and hatches are closed.

The integrity of seals on doors, hatches and other penetrations (e.g., instrumentation access ports) is to be verified before each test.

3.2.3 Engine/Bilge mock-up

a) An engine mock-up is to be constructed in steel, plate, thickness at least 3 mm, with sizes (width x length x height) 1.0 x 1.8 m x 1.4 m. The mock-up is to be fitted with two steel tubes diameter 0.25 m and 1.8~~4~~ m length, that simulate exhaust manifolds, and a solid steel plate on top as per figures. ~~The top of the mock-up is to provide a 1.35 m^2 tray and a s~~Spray ~~(C)~~ is to be placed below the overhanging steel plate on top of the mock-up (see figures 1, 2 and 3 (not in scale)) for test enclosure having volume V from 80 m^3 up to 140 m^3. For volumes up to 80 m^3, see Fig 4 and Fig 5 (out of scale).

b) A bilge system is to be created by a floor plate system located close to the sides of the engine mock-up with a wall around, fitted to the floor of test room: fuel trays placed underneath the engine simulate fuel accumulation (hidden pool fire) and open pool fire.

c) Provisions are to be made for placement of the fuel trays, as described in Tab 1 (Volume > 70 m^3) and Tab 3 (Volume ≤ 70 m^3), and located as described in figures.

d) Polymeric sheets installed in suitable racks as per Fig 6 and Fig 7 are to be provided.

3.3 Instrumentation

~~Instrumentation for the continuous measurement and recording of test conditions is to be employed.~~ The following measurements are to be made:

a) continuous temperature monitoring at ~~two~~ three vertical positions (e.g. 1 m, 2,5 m, etc.);
b) enclosure pressure;
c) ~~gas sampling and~~ oxygen analysis, at mid-room height, ~~for oxygen, carbon dioxide, carbon monoxide and other relevant products~~ before the test;
d) means of determining flame-out indicators;
e) fuel nozzle pressure in the case of spray fires
f) fuel flow rate in the case of spray fires;
~~g) discharge nozzle pressure; and~~
h) means for determining discharge duration (discharge test to be conducted before fire test, e.g. visual examination through suitable window).

Figure 1

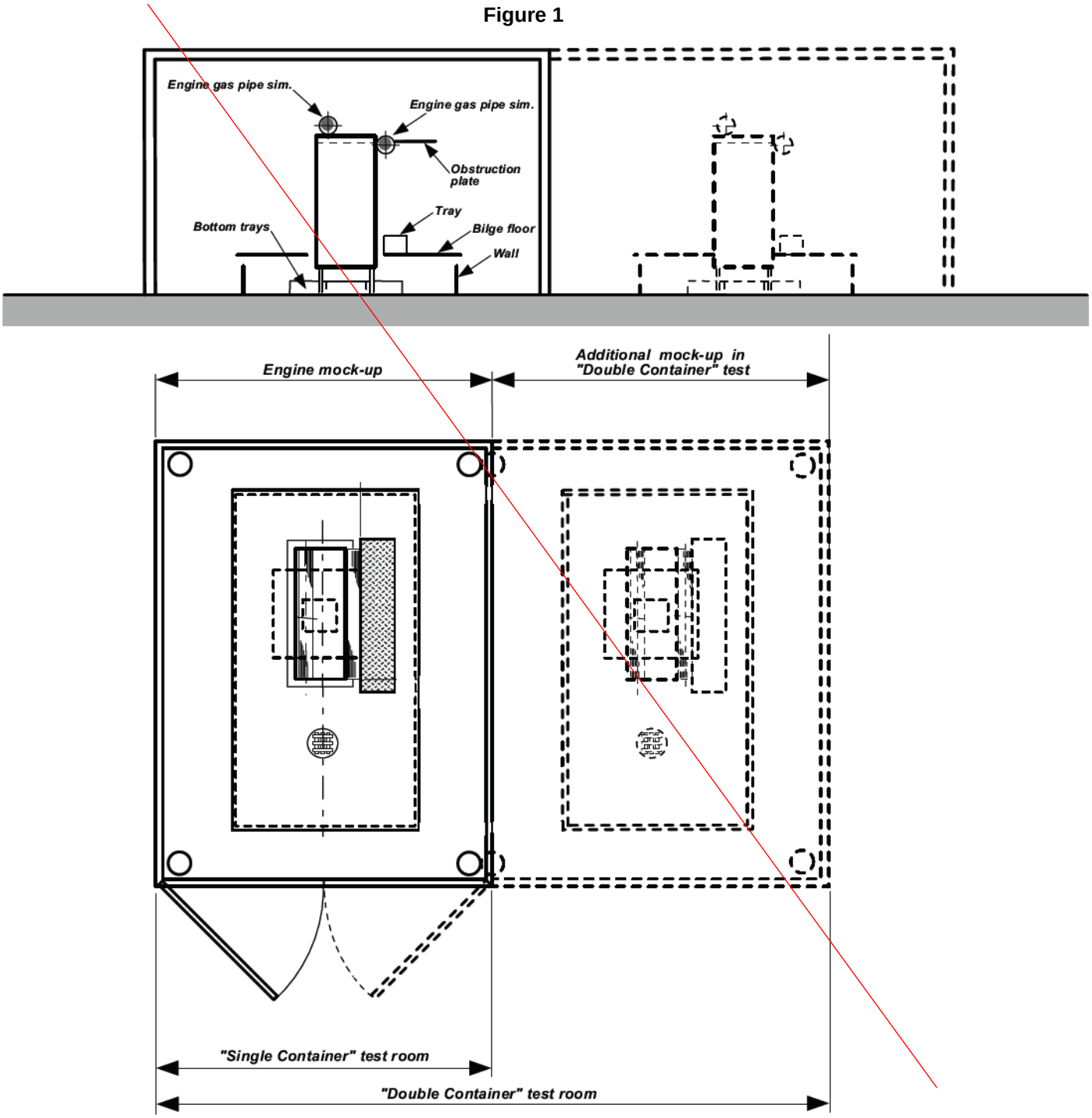

Engine gas pipe sim.
Engine gas pipe sim.
Obstruction plate
Tray
Bilge floor
Bottom trays
Wall
Engine mock-up
Additional mock-up in "Double Container" test
"Single Container" test room
"Double Container" test room

Figure 2

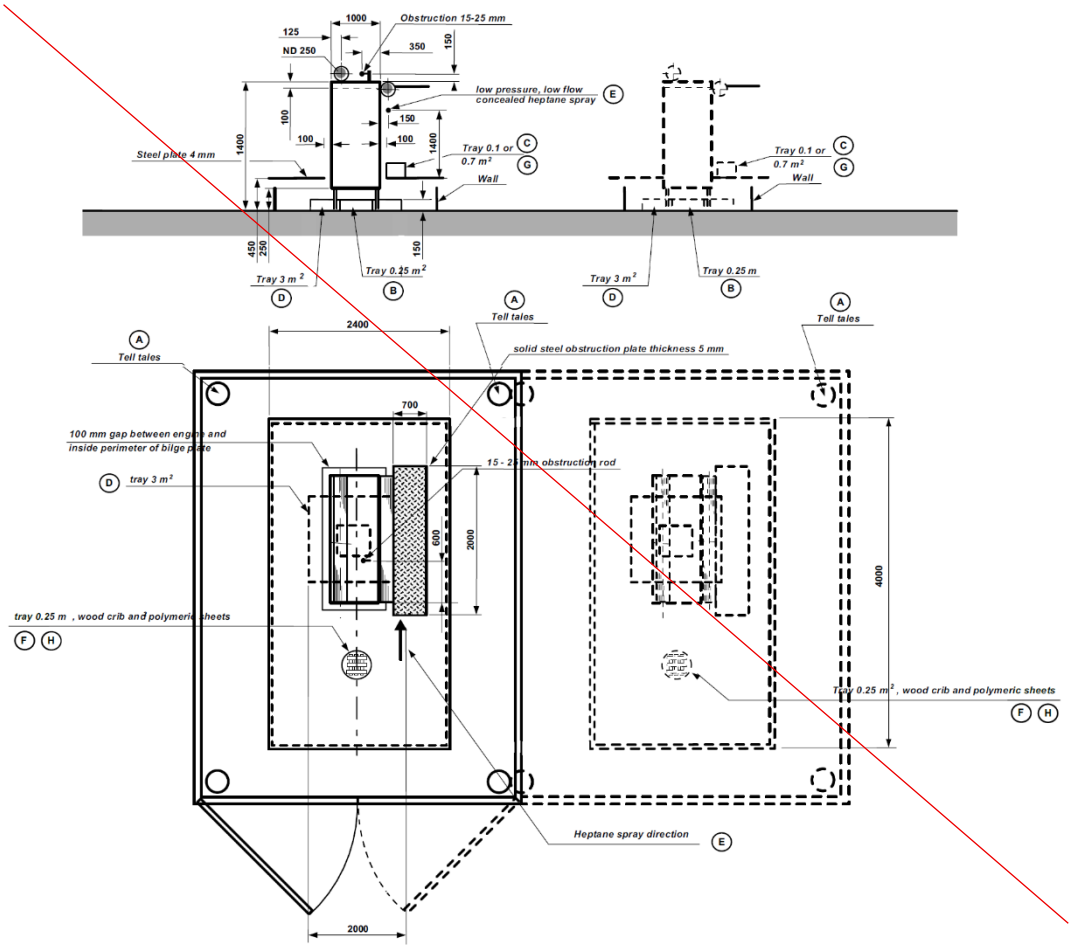
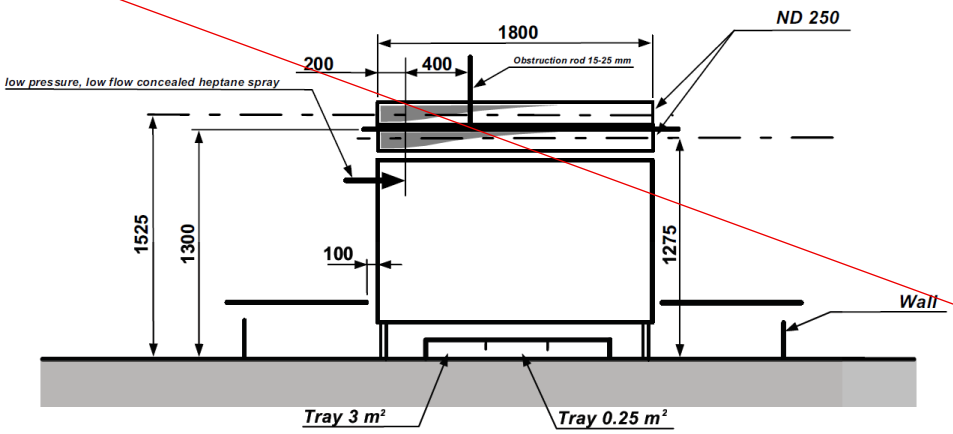


Figure 3



3.4 Nozzles

a) For test purposes, nozzles are to be located as recommended by the manufacturer.
b) If more than one nozzle is used, they are to be symmetrically located.

3.5 Enclosure temperature

The ambient temperature of the test enclosure at the start of the test is to be noted.

3.6 Test Fires and Programme for volumes between 70 m^3 and 140 m^3

3.6.1 Fire Types

The test programme, as described in Tab 3, should employ test fires as described in Tab 1 and Tab 2 below.

Table 1: Parameters of test fires

Fire	Type	Fuel	Fire size, MW	Remarks
A	76 – 100 mm ID can up	Heptane	0.0012 to 0.002	Tell tale
B	0.25 m^2 tray	Heptane	0.35	(See Note 1)
C	0.70 m^2 tray	Diesel/fuel oil	1	(See Note 1)
D	3 m^2 tray	Diesel/fuel oil	4.4	(See Note 1)
E	Low pressure, low flow spray	Heptane 0.03 ± 0.005 kg/s	1.1	
F	Wood crib	Spruce or fir	0.3	(See Note 2)
G	0.10 m^2 tray	Heptane	0.14	
H	Polymeric sheets	PMMA, Polypropylene, ABS		(See Note 3)

Notes:

1) Diesel/Fuel oil means light diesel or commercial fuel oil.
2) The wood crib should be substantially the same as described in standard ISO 14520-1:2006 (Gaseous fire extinguishing systems, Physical properties and system design, Part 1: General Requirements). The crib should consists of six members of trade size 50 mm x 50 mm x 450 mm, kiln dried spruce or fir lumber having a moisture content between 9 and 13%. The members should be placed in 4 alternate layers at right angles to one another. Members should be evenly spaced forming a square structure. Ignition of the crib should be achieved by burning commercial grade heptane in a square steel tray 0.25 m^2 in area. During the pre-burn period the crib should be placed centrally above the top of the tray at a distance of 300 to 600 mm.
3) For the polymeric sheet fire test should be substantially the same as described in standard ISO 14520-1:2006 (Gaseous fire extinguishing systems, Physical properties and system design, Part 1: General Requirements) see [3.2.3] d).

Table 2: Spray fire test parameters

Fire type	Low pressure, Low flow (E)
Spray nozzle	Wide spray angle (80°) Full cone type
Nominal fuel pressure	8.5 bar
Fuel flow	0.03 ± 0.005 kg/s
Fuel temperature	20 ± 5 °C
Nominal heat release rate	1.1 ± 0.1 MW

3.6.2 Test Programme

a) The fire test programme should employ is to foresee single test fires or in combination, as outlined in Tab 3 below.

b) All applicable tests of Tab 3 should are to be conducted for every new fire-extinguishing media.

c) Only test 1 is required to evaluate In the case of nozzles/ and related distribution system equipment (hardware) for systems employing fire-extinguishing media that have successfully completed the requirements of [3.6.1] [3.3.2.2] above. Test 1 should be conducted to establish and verify the manufacturer's minimum nozzle design pressure a test with fire class A only is required to evaluate the minimum quantity of extinguishing medium concentration declared by the manufacturer.

d) Polymeric sheets are to be arranged in three racks (one for each polymeric material) containing 4 sheets each as per Fig 6 and Fig 7.

3.7 Test Fires and Programme for volumes up to 80 m^3

3.7.1 Fire Types

The test programme as described in Tab 6, is to be performed according to test fires as described in Tab 4 and Tab 5 below.

Table 3: Test programme

Test No.	Fire combination (see table 1)
1	A: Tell tales, 8 corners. (see note 1)
2	B: 0.25 m^2 heptane tray under mock-up G: 0.10 m^2 heptane tray on deck plate located below solid steel obstruction plate Total fire load: 0.49 MW ~~(see note 2)~~
3	C: 0.70 m^2 diesel/fuel oil tray on deck plate located below solid steel obstruction plate F: Wood crib positioned as in figure 2 E: Low pressure, low flow horizontal spray − concealed − with impingement on inside of engine mock-up wall. H: Polymeric sheets positioned as in figure 2 Total fire load: 3.4 MW (~~see note 3~~ C+F+E)
4	D: 3 m^2 diesel tray under engine mock-up Total fire load: 4.4 MW ~~(see note 4)~~

~~**Notes:**~~

1) Tell-tale fire cans should be located as follows:
   a. in upper corners of enclosure 150 mm below ceiling and 50 mm from each wall; and
   b. in corners on floors 50 mm from walls.
   ~~c in case of "double container" test, 12 tell tales are required.~~

~~2) In case of "double container" test, B fires are to be ignited in both mock-ups.~~

~~3) In case of "double container" test, F and H fires are to be ignited in both mock-ups.~~

~~4) In case of "double container" test, D fire is to be ignited in both mock-ups.~~

Table 4: Parameters of test fires up to 80 m^3

Ref.	Fire	Constituents	Q.ty	Container type	Container size
CUPS	Cups 1-8	Heptane	0.3 l/ cup one at each angle of the room	Open tin approx. 100 mm diameter	100 mm x 100 mm = 0.75 l
A	Tray A	Engine lube oil Diesel fuel oil **(1)**	3.5 l 1.5 l	Steel tray	1000 cm x 500 cm = 0.5 m^2
B	Tray B	Diesel fuel oil **(1)** Heptane:	10 l 0.25 l	Steel tray	1200 cm x 800 cm = 0.96 m^2
C	Spray C	Hidden spray fire – Diesel fuel oil **(1)**	1.1 l/min	Pressurized container at 3 bar pressure	
D	Wood crib	Spruce or fir			
E	Polymeric sheets	PMMA, Polypropylene, ABS			

(1) Diesel/Fuel oil means light diesel or commercial fuel oil.

(2) The wood crib consists of six members of trade size 50 mm x 50 mm x 450 mm, kiln dried spruce or fir lumber having a moisture content between 9 and 13%. The members should be placed in alternate layers at right angles to one another. Members should be evenly spaced forming a square structure. Ignition of the crib should be achieved by burning commercial grade heptane in a square steel tray 0.25 m^2 in area. During the pre-burn period the crib should be placed centrally above the top of the tray at a distance of 300 to 600 mm.

(3) The polymeric sheet fire test arrangement see [3.7.2] d)

Table 5: Spray fire test parameters up to 80 m^3

Fire type	Spray fire (C)
Spray nozzle	Wide spray angle (80°) Full cone type
Nominal fuel pressure	8.5 bar
Fuel flow	0.03 ± 0.005 kg/s
Fuel temperature	20 ± 5 °C
Nominal heat release rate	1.1 ± 0.1 MW

Table 6: Test programme up to 80 m^3

Test No.	Fire combination (see Tab 1 for fire specification)
1	CUPS+B **(1)**
2	A+C+D
3	A+C+E
4	CUPS+A+B+C **(1)**
1) Tell-tale fire cups should be located as follows: a. in upper corners of enclosure 150 mm below ceiling and 50 mm from each wall; and b. in corners on floors 50 mm from walls.	

3.7.2 Test programme

a) The fire tests programme is to be performed as outlined in Tab 6.

b) All applicable tests of Tab 6 are to be conducted for every new fire-extinguishing media.

c) In the case of new nozzles/distribution system equipment (hardware) for systems employing fire-extinguishing media that have successfully completed the requirements of [3.6.3], a test with fire CUPS only is required to verify the minimum extinguishing medium quantity declared by the manufacturer.

d) Polymeric sheets are to be arranged in one rack containing 3 polymeric sheets (one for each polymeric material). Rack construction is to be as per Fig 6 and Fig 7.

3.8 Extinguishing system

3.8.1 System installation

The extinguishing system tested under [3.6] and [3.7] is to be installed according to the Manufacturer's design and installation instructions.

3.8.2 Quality of agent

The minimum quantity of agent is determined by means of the full scale fire tests as per [3.6] and [3.7] according to the Manufacturer's design.

3.9 Procedure

3.9.1 Fuel level in trays

The trays used in the test are to be filled with at least 30 mm fuel on a water base. Freeboard is to be 120 ± 10 mm.

3.9.2 Fuel flow and pressure measurements

For spray fires, the fuel flow and pressure are to be measured before and during each test.

3.9.3 Ventilation

a) Pre-burn period
During the pre-burn period the test enclosure is to be well ventilated. The oxygen concentration, as measured at mid-room height, is to be not less than 20 per cent volume at the time of system discharge.

b) End of pre-burn period
Doors, ceiling hatches and other ventilation openings are to be closed at the end of the pre-burn period.

3.9.4 Duration of test

a) Pre-burn time

Fires are to be ignited such that the following burning times occur before the start of agent discharge:

1) sprays - 5 to 15 s

2) trays - 2 min

3) wood crib ~~3 separate test, one of 2 min, one of 4 min and one of~~ - ~~6~~ 4 min; and

4) polymeric sheets – 210 s.

b) Discharge time

The minimum design quantity in 10 s or less.

c) Hold period

After the end of agent discharge, the test enclosure is to be kept closed for 15 min.

The test is to involve the attempted ignition of two of the tell-tale fire containers. One container is to be at the floor level and the other at the ceiling level at the diagonally opposite corner. At 10 min after extinguishment of the fires, a remotely operated electrical ignition source is to be energized for at least 10 s at each container. The test is to be repeated at one min intervals four more times, the last at 14 min after extinguishment. Sustained burning for 30 s or longer of any of these ignition attempts constitutes a re-ignition test failure.

3.10 Measurements and observations

a) Before test

1) temperature of test enclosure, fuel and engine mock-up;
2) initial weights of agent containers;
3) verification of integrity agent distribution system and nozzles;
4) initial weight of wood crib.

b) During test

1) start of the ignition procedure;
2) start of the test (ignition);
3) time when ventilating openings are closed;
4) time when the extinguishing system is activated;
5) time from end of agent discharge;
6) time when the fuel flow for the spray fire is shut off;
7) time when all fires are extinguished;
8) time of re-ignition, if any, during hold period9) time at end of hold period; and
9) at the start of the test, initiate continuous monitoring as per [3.3].

c) After test

1) weight of agent containers;
2) verification that the bottom of trays is covered by fuel;
3) final weight of wood crib.

3.11 Tolerances

Unless otherwise stated, the following tolerances are to apply ~~(ref. standard ISO 6182-1:2004)~~:

a) length ±2% of value;
b) volume ±5% of value;
c) pressure ±3% of value;
d) temperature ±5% of value; and
e) concentration ±5% of value.

4 ACCEPTANCE CRITERIA

4.1

Class B fires are to be extinguished within 30 s of the end of agent discharge. At the end of the hold period there is to be no re-ignition upon opening the enclosure.

4.2

The fuel spray is to be shut off 15 s after extinguishments. At the end of the hold period, the fuel spray is to be restarted for 15 s prior to re-opening the door and there is to be no re-ignition.

4.3

The ends of the test fuel trays are to contain sufficient fuel to cover the bottom of the tray.

4.4

~~A re-ignition test is to be conducted after the successful extinguishments of the fires in test 1(Fire A) within 30 s after completion of discharge. The test is to involve the attempted ignition of two of the tell-tale fire containers. One container is to be at the floor level and the other at the ceiling level at the diagonally opposite corner. At 10 min after extinguishment of the fires, a remotely operated electrical ignition source is to be energized for at least 10 s at each container. The test is to be repeated at 2 min intervals two more times, the last at 14 min after extinguishment. Sustained burning for 30 s or longer of any of these ignition attempts constitutes a re-ignition test failure~~The wood crib weight loss should be no more than 50% at the end of the test.

4.5

When performing the re-ignition test as per [3.9.4] a fire sustained burning for 30 s or longer of any of the re-ignition attempts constitute a reignition test failure.

4.6

For the polymeric sheets, the test is satisfactory ~~laboratory extinguishing factor for each fuel is that which achieves satisfactory extinguishment of the fire over three successive tests (~~when no flaming is present 60 s after end of discharge and no re-ignition after 10 min from end of discharge~~). The design factor is the highest of the laboratory extinguishing factors for the three fuels multiplied by 1.3~~ and no re-ignition happens when opening the test room.

4.7

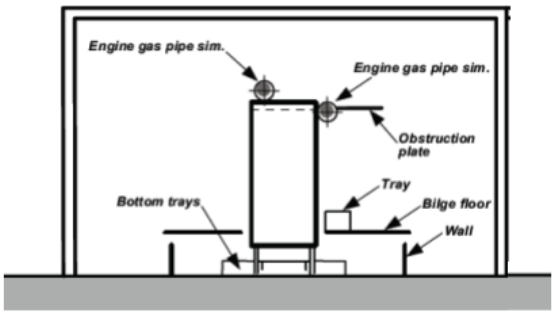
The extinguishing medium quantity used for the successful performance of the tests is to be measured considering the net volume of the test enclosure.

5 TEST REPORT

The test report is to include the following information:

a) name and address of the test laboratory;
b) date and identification number of the test report;
c) name and address of the client;
d) purpose of the test;
~~e) method of sampling system components;~~
f) name and address of the Manufacturer or Supplier of the product;
g) name or other identification marks of the product;
h) description of the tested product;
   1) drawings;
   2) technical descriptions;
   3) assembly instructions;
   4) specification of included materials; and
   5) detailed drawing of test set-up;
i) date of supply of the product;
j) date of test;
k) test method;
l) drawing of each test configuration;
m) identification of the test equipment and used instruments;
n) conclusions;
o) deviations from the test method, if any;
p) test results including measurements and observations during and after the test; and
q) v) date and signature.

Figure 1



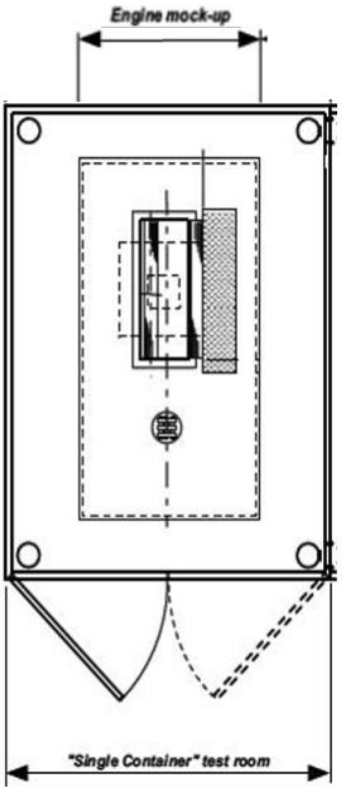
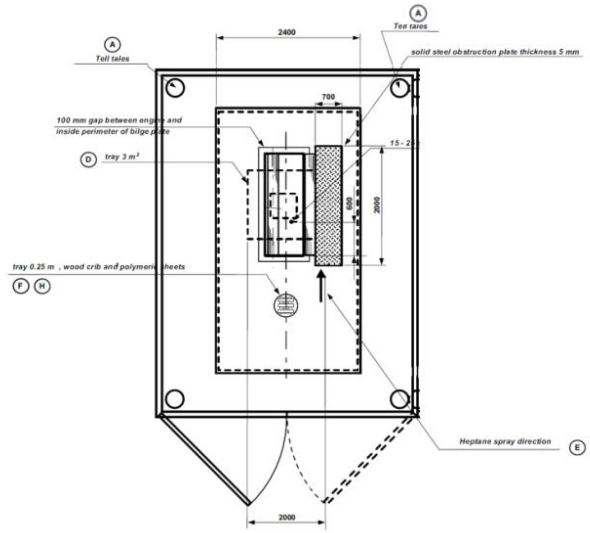


Figure 2



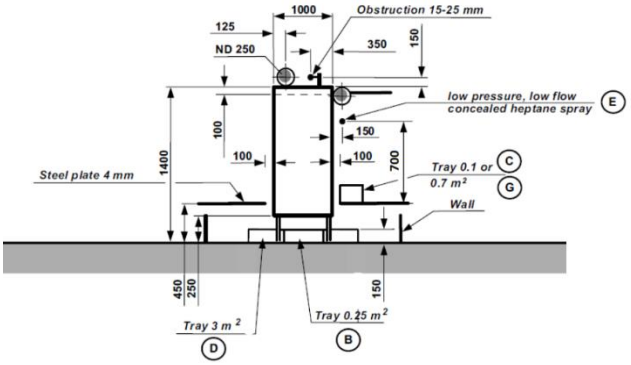


Figure 3

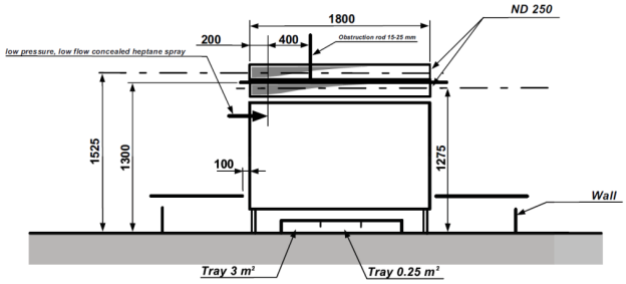


Figure 4

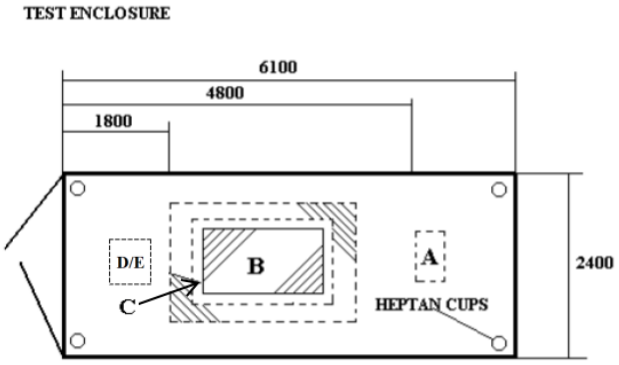


Figure 5: Engine mock-up

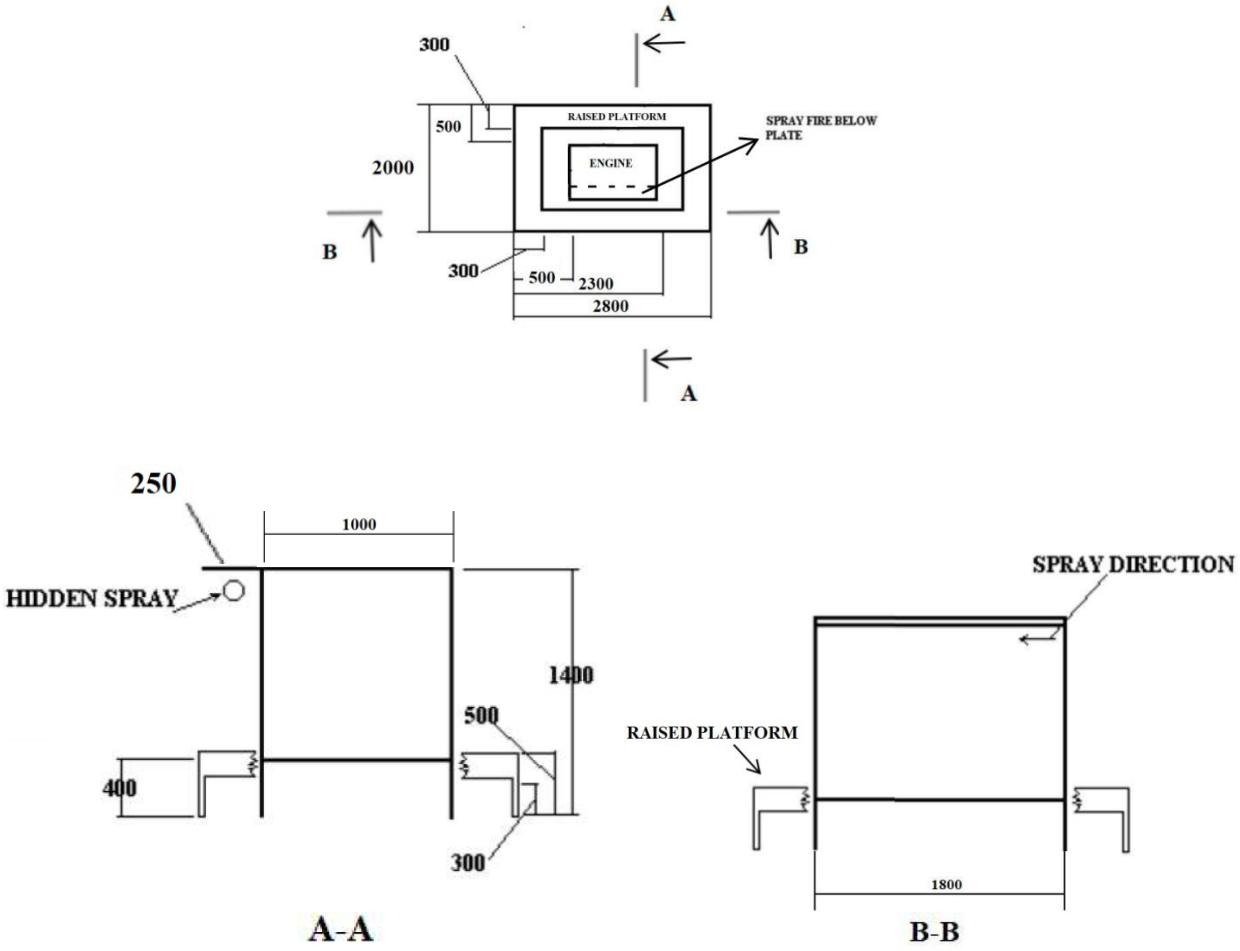
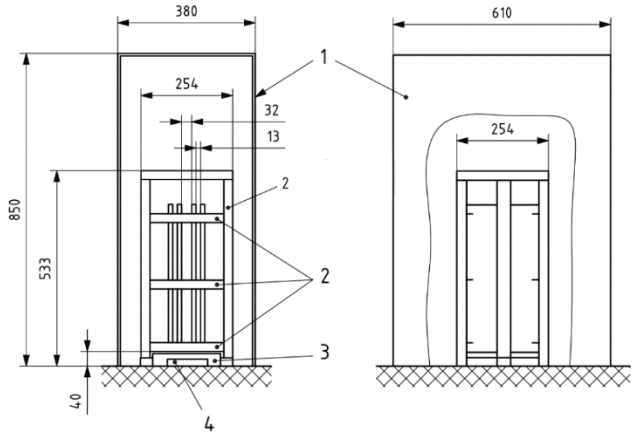


Figure 6: Polymeric sheets fire test arrangment



1. Steel box open at two ends, closed on the sides and on top
2. Steel angle bars for polymeric sheets positioning

Figure 7: Supporting frame for polymeric sheets