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GUIDELINES FOR THE APPROVAL OF FIXED PRESSURE WATER-SPRAYING AND WATER-BASED FIRE-EXTINGUISHING SYSTEMS FOR CABIN BALCONIES

1 The Committee, at its eighty-fourth session (7 to 16 May 2008), having recognized the need for guidelines for the approval of fixed pressure water-spraying and water-based fire-extinguishing systems for cabin balconies, taking into account the amendments to SOLAS chapter II-2 and the FSS Code adopted by resolutions MSC.216(82) and MSC.217(82), considered the proposal by the Sub-Committee on Fire Protection at its fifty-second session (14 to 18 January 2008) and approved the Guidelines for the approval of fixed pressure water-spraying and water-based fire-extinguishing systems for cabin balconies, set out in the annex.

2 Member Governments are invited to apply the annexed Guidelines when approving fixed pressure water-spraying and water-based fire-extinguishing systems for cabin balconies on passenger ships for systems to be installed on or after 1 July 2008 and bring them to the attention of ship designers, ship owners, equipment manufacturers, test laboratories and other parties concerned.

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ANNEX

GUIDELINES FOR THE APPROVAL OF FIXED PRESSURE WATER-SPRAYING AND WATER-BASED FIRE-EXTINGUISHING SYSTEMS FOR CABIN BALCONIES

1 General

Fixed pressure water-spraying fire-extinguishing systems, as required by SOLAS regulation II-2/10.6.1.3, for the protection of cabin balconies where furniture and furnishings other than those of restricted fire risk are used should be shown by testing to have the capability of suppressing typical fires expected in such areas, and preventing them from spreading to the adjacent cabins and to other balconies. These Guidelines should be applied when approving fixed pressure water-spraying and water-based fire-extinguishing systems for cabin balconies on passenger ships to be installed on or after 1 July 2008.

1.2 Definitions

1.2.1 *Automatic system* is a system with automatic nozzles. Each head should be individually activated by heat from the fire before water will be discharged.

1.2.2 *Manually released system* is a pipework system with open nozzles, controlled by section valves. When a section valve is opened, all of the connected nozzles will discharge water simultaneously.

2 Principal requirements for the system

2.1 The system should either be automatic or capable of manual release from a location remote from the protected area.

2.2 The system should be capable of fire suppression based on testing conducted in accordance with the appendix to these Guidelines.

2.3 The system should be capable of fire suppression on open deck areas with expected wind conditions while the vessel is underway. The fire test does not require the use of actual wind velocities; instead, a nominal wind speed is included to account for variables in balcony geometry and related issues. Although the test ventilation conditions are intended to provide a safety factor, it is recognized that in an actual fire, the master and crew are expected to take appropriate actions to manoeuvre the ship to assist the suppression system.

2.4 The system should be available for immediate use and capable of continuously operating for at least 30 min.

2.5 The system and its components should be suitably designed to withstand ambient temperature changes, vibration, humidity, shock, impact, clogging and corrosion normally encountered on open deck areas. Open head nozzles should be tested in accordance with appendix A of MSC/Circ.1165*. Automatic nozzles should be tested in accordance with appendix 1 of resolution A.800(19)*.

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* These IMO instruments have been amended by MSC/Circ.1269 and resolution MSC.265(84), respectively.

2.6 The location, type and characteristics of the nozzles should be within the limits tested, as referred to in the appendix. Nozzle positioning should take into account obstructions to the spray of the fire-fighting system. Automatic nozzles should have fast response characteristics as defined in ISO standard 6182-1:2004.

2.7 The piping system should be sized in accordance with a hydraulic calculation technique such as the Hazen-Williams hydraulic calculation technique* and the Darcy-Weisbach hydraulic calculation technique, to ensure availability of flows and pressures required for correct performance of the system.

2.8 The minimum capacity and design of the supply system for a manually released system should be based on the complete protection of the most hydraulically demanding section. The minimum capacity and design of the supply system for an automatic system should be based on the complete protection of the eight most hydraulically remote balconies, but not to exceed 50 m^2.

2.9 The water supply for cabin balcony systems may be fed from an independent supply, or they may be fed from the supply to another water-based fire-fighting system providing that adequate water quantity and pressure are available as indicated below:

.1 Manually released systems: The water supply should be capable of supplying the largest balcony section and, if supplied by the sprinkler system, the capacity should be adequate to supply eight adjacent cabins. If supplied by the fire main, the system should be capable of supplying the largest balcony section plus the two jets of water required by SOLAS regulations II-2/10.2.1.3 and II-2/10.2.1.6.

.2 Automatic systems: The water supply should be capable of supplying the eight most hydraulically demanding balconies, but not to exceed 50 m^2. If combined with the sprinkler system, the design area in total need not exceed 280 m^2.

2.10 The system should be grouped into sections. A manually released section should not serve cabin balconies on both sides of the ship, except that the same section may serve balconies located on one side of the ship and balconies in the fore or aft end of the ship.

2.11 The system section valves and operation controls should be located at easily accessible positions outside the protected space, not likely to be cut off by a fire in the cabin balconies.

2.12 A means for testing the operation of the system for assuring the required pressure and flow should be provided.

2.13 Activation of any water supply pump should give a visual and audible alarm at a continuously manned central control station or onboard safety centre.

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* Where the Hazen-Williams Method is used, the following values of the friction factor "C" for different pipe types which may be considered should apply:

Pipe type	C factor
Black or galvanized mild steel	100
Copper and copper alloys	150
Stainless steel	150

2.14 Any parts of the system which may be subjected to freezing temperatures in service should be suitably protected against freezing.

2.15 The system should be provided with a redundant means of pumping or otherwise supplying the discharge nozzles. The capacity of the redundant means should be sufficient to compensate for the loss of any single pump or supply source. The system should be fitted with a permanent sea inlet and be capable of continuous operation using seawater.

2.16 Operating instructions for the system should be displayed at each operating position.

2.17 Spare parts and operating and maintenance instructions for the system should be provided as recommended by the manufacturer.

2.18 Dry pipe systems should be arranged such that water will discharge from the farthest sprinkler within 60 s of actuation of the sprinkler.

APPENDIX

TEST METHOD FOR FIXED PRESSURE WATER-SPRAYING AND WATER-BASED FIRE-EXTINGUISHING SYSTEMS FOR CABIN BALCONIES

1 SCOPE

1.1 This test method is intended for evaluating the effectiveness of fixed pressure water-spraying and water-based fire-extinguishing systems for cabin balconies.

1.2 It was developed for ceiling or sidewall mounted nozzles located to protect external cabin balconies that are open to the atmosphere with natural wind conditions.

1.3 Systems for the protection of cabin balconies are intended for either automatic or manual operation.

2 GENERAL REQUIREMENTS

2.1 The nozzles and other system components should be supplied by the manufacturer with design and installation criteria, operating instructions, drawings, and technical data sufficient for the identification of the components.

2.2 Temperatures should be measured using plain K-type thermocouple wires not exceeding 0.5 mm in diameter. The thermocouple beads should be shielded to protect against direct water impingement.

2.3 Unless otherwise stated, the following tolerances should apply:

.1 Length ± 2% of value
.2 Pressure ± 3% of value
.3 Temperature ± 2% of value.

2.4 System water pressure should be measured by using suitable equipment. Total water flow rates should be determined by a direct measurement or indirectly by using the pressure data and k-factor of the nozzles.

2.5 Wind velocity should be measured by using suitable equipment.

2.6 The temperature and pressure measurements should be made continuously, at least once in every two seconds throughout the tests.

2.7 The tests should simulate the conditions of an actual installed system regarding objectives such as time delays between the activation of the system and minimum system water pressure or water delivery. In addition, the use of a pre-primed fire suppression enhancing additive, if applicable, should be taken into account.

3 FIRE TESTS

3.1 Test principles

3.1.1 These tests are intended to evaluate the fire-suppression capabilities of nozzles used for the protection of cabin balconies against external fires in furniture and furnishings of other than restricted fire risk. The primary objective of the test is to evaluate the ability of the system to prevent a fire on a cabin balcony from spreading to the adjacent cabin and to other balconies.

3.1.2 The tests also define the following design and installation criteria:

.1 the maximum coverage (length and width) of a single nozzle; and

.2 the minimum operating pressure.

3.2 Test description

3.2.1 *Fire test compartment*

3.2.1.1 These tests are intended to evaluate the nozzle's fire-suppression capabilities against external fires on open cabin balconies. The tests may be conducted inside a well ventilated test hall having a specified area of at least 100 m^2, a specified height of at least 5 m and adequate natural or forced ventilation to ensure that there is no restriction in air supply to the test fires. The fire test hall should have an ambient temperature of 20 ± 5°C at the start of each test.

3.2.2 *Apparatus*

3.2.2.1 The fire tests should be conducted in a test apparatus consisting of a balcony mock-up in accordance with figure 1. The balcony ceiling should be smooth to allow an unobstructed flow of gases.

3.2.2.2 The mock-up should be constructed of nominally 12 mm thick non-combustible wallboard panels. Plywood panels should be attached to the wall below the ventilation channel opening, and on the back wall, covering at least 2 m horizontally, starting from the fan side corner. The panels should be 2 m high and 3 to 4 mm thick. The ignition time of the panel should not be more than 35 s and the flame spread time at 350 mm position should not be more than 100 s as measured in accordance with the FTP Code. Prior to the test, the plywood panels should be conditioned at 21 ± 2.8º C and 50 ± 10% relative humidity for at least 72 h.

3.2.2.3 The dimensions of the balconies should be in accordance with figure 1, or may be increased up to the maximum coverage area (length and width) to be protected by one nozzle.

3.2.2.4 A fan should be attached to the balcony mock-up, as indicated in figure 1. The fan should provide an average air velocity of 5 ± 0.2 m/s measured as an average over several locations. Typically, sufficient dimensions of the fan are 0.8 m in diameter with a power of 5.5 kW.

3.2.2.5 For ceiling nozzles, the velocity measurements should be done at nine locations; at the nozzle and around it on a circle of 0.5 m radius (figure 3(a)). For sidewall nozzles, the measurement should be done in six locations, at the nozzle and around it on a half-circle of 0.5 m radius (figure 3(b)). In vertical direction, the measurement should be done in the middle of the wind channel (25 cm from the ceiling). The intention is to distribute measurement locations over the region where the wind affects the suppression medium flow.

3.2.3 *Fire source*

3.2.3.1 The fire source should consist of a wood crib, two simulated chairs and a table mock-up.

3.2.3.2 Each chair should be fitted with two 0.5 m by 0.8 m by 0.1 m polyether cushions. The cushions should be made of non-fire retardant polyether and they should have a density of approximately 33 kg/m^3. When tested according to standard ISO 5660-1 (ASTM E-1354), the polyether foam should give results as given in the table below. Prior to the test, the cushions should be conditioned at 21 ± 2.8ºC and 50 ± 10% relative humidity for at least 72 h.

The frame of the chairs should be of steel nominally 2 mm thick consisting of rectangular bottom and backrest frames constructed of steel angles, channels or rectangular stock of at least 3 mm thickness. The frame dimensions should be 0.5 m x 0.8 m (figure 2). The seat and backrest cushions should be supported on each frame by steel bars 20-30 mm wide x 0.80 m long located in the centre of the frames and welded to the edges. Steel plates should not be used to support the cushions. The assembled frames should be supported by four legs 500 mm in height constructed of similar steel stock. The frames should be equipped with a metal wire net to support the cushions, and the backrest should be tied in place, to keep from falling over during the test. The backrest should be placed on top of the seat cushion.

ISO 5660: Cone calorimeter test

Test conditions:

Irradiance 35 kW/m^2
Horizontal position
Sample thickness 50 mm
No frame retainer should be used

Test results	**Foam**
Time to ignition (s)	2-6
3 min average HRR, q_{180}	270 ± 5 0
Minimum heat of combustion (MJ/kg)	25
Total heat release (MJ/m^2)	50 ± 1 2

3.2.3.3 A table should be constructed of a similar steel stock as the chairs. The table should have a 0.5 m by 0.5 m metal frame, supported by four legs, 520 mm in height. A 0.5 m by 0.5 m table plate should be fitted into the frame, made of 2 mm thick steel.

3.2.3.4 The two chairs should be placed in the fan side corner of the balcony, in such a way that the polyether foam is 0.1 m from the plywood panel, according to figures 3 and 4, corners of the cushions touching. The table should be placed in the corner, edges aligned with the ends of the chairs.

3.2.3.5 The wood crib should be dimensioned 0.3 m x 0.3 m x 0.15 m (high). The crib should consist of four alternate layers of four trade size nominal 38 mm x 38 mm kiln-dried spruce or fir lumber 0.3 m long. The alternate layers of the lumber should be placed at right angles to the adjacent layers. The individual wood members in each layer should be evenly spaced along the length of the previous layer of wood members and stapled together. After the wood crib is assembled, it should be conditioned at a temperature of 50 ± 5ºC for not less than 16 h. Following the conditioning, the moisture content of the crib should be measured at various locations with a probe-type moisture meter. The moisture content of the crib should not exceed 5% prior to the fire test.

3.2.3.6 A square steel tray of area 0.1 m^2 and height 0.1 m should be located under the table, so that its corner is next to the point where chairs touch. The wood crib should be supported directly over the tray, edges aligned with the chair ends. The top of the wood crib should be 0.27 m above the floor level (figure 4).

3.2.3.7 For ignition, the tray should be filled with 1 *l* of water and 250 ml of commercial heptane.

3.2.4 *Nozzle installation requirements*

3.2.4.1 The tests with the given balcony dimensions are intended for a single nozzle protection. The single nozzle has to be located symmetrically in the balcony, at the centreline in the position recommended by the manufacturer's installation instructions, vertically at least 0.4 m above the lower edge of the wind channel. The two most conceivable locations are shown in figure 3.

3.2.4.2 If the nozzle is located closer to the fan side wall than at the centreline, the protection width of the nozzle will be less than 3 m, i.e. twice the tested distance between the nozzle and wall. If a larger than 3 m protection width is aimed at, a wider balcony should be constructed for the test.

3.2.4.3 The nozzle should be connected to a suitable water supply and arranged to operate at the minimum pressure specified by the manufacturer.

3.2.4.4 The tests should be repeated using two nozzle orientations, where applicable. At first, the lowest discharge density should be directed towards the cabin wall, and then, towards the fan side wall.

3.2.5 *Instrumentation*

3.2.5.1 Thermocouples should be installed at four locations; two on the front edge of the balcony ceiling, one 1 m and the other 2 m from the fan side wall, one of the back edge of the ceiling, 2 m from the fan side wall and one in the centre of the side wall opposite the fan. Thermocouples should be installed 30 mm from the ceiling.

3.2.5.2 System water pressure should be measured near the nozzle, and the system water flow rate should be defined with suitable means for the system.

4 TEST METHOD

4.1 Test programme

4.1.1 Two tests should be done for each type of nozzle. One test with wind, and one without.

4.1.2 In the wind test, the fan should be started before ignition and operated continuously during the test. The wind velocity should be measured when it has levelled, before ignition as defined in paragraph 3.2.2.5.

4.1.3 Automatic nozzles should be tested with the fusible element removed.

4.2 Ignition

The heptane in the tray should be ignited using a gas burner, long stick, match or equivalent.

4.3 Determination of pre-burn time

Prior to conducting the nozzle tests, the pre-burn time should be determined using materials from the same lots to be used during system approval testing.

A minimum of two free-burn tests should be conducted with wind and two without wind. In each test, the flame attachment time to the wall should be recorded. The system activation time used during the nozzle tests with wind should be 30 s less than the average flame attachment time recorded in the free-burn tests with wind. The system activation time used during the nozzle tests without wind should be 30 s less than the average flame attachment time recorded in the free-burn tests without wind.

4.4 Test duration

The sprinkler system should be manually activated at the end of the pre-burn period. The test should be conducted for 10 min after the sprinkler system is activated, and any remaining fire should be manually extinguished.

4.5 Observations during the test

During the test, the following observations should be recorded:

.1 activation time of ventilation system (if applicable);

.2 time of ignition;

.3 activation time of the extinguishing system;

.4 time of ignition of the plywood panels (if any);

.5 time of extinguishment, if any; and

.6 time when the test is terminated.

5 ACCEPTANCE CRITERIA

5.1 For all tests, there should be no ignition of the plywood panels.

5.2 For the test without wind, 30 s after activation of the system, none of the thermocouples should show temperatures exceeding 100ºC.

6 TEST REPORT

The test report should, as a minimum, include the following information:

.1 name and address of the test laboratory;

.2 date of issue and identification number of the test report;

.3 name and address of applicant;

.4 name and address of manufacturer or supplier of the nozzles;

.5 test method and purpose;

.6 nozzle identification;

.7 description of the tested nozzle;

.8 detailed drawings/photos of the test set-up;

.9 date of tests;

.10 measured nozzle pressure and flow characteristics;

.11 identification of the test equipment and used instruments;

.12 test results including observations and measurements made during and after the test:

  .1 maximum protected area per nozzle; and

  .2 minimum operating pressures;

.13 deviations from the test method;

.14 conclusions; and

.15 date of the report and signature.

Figure 1: Balcony Mock-up

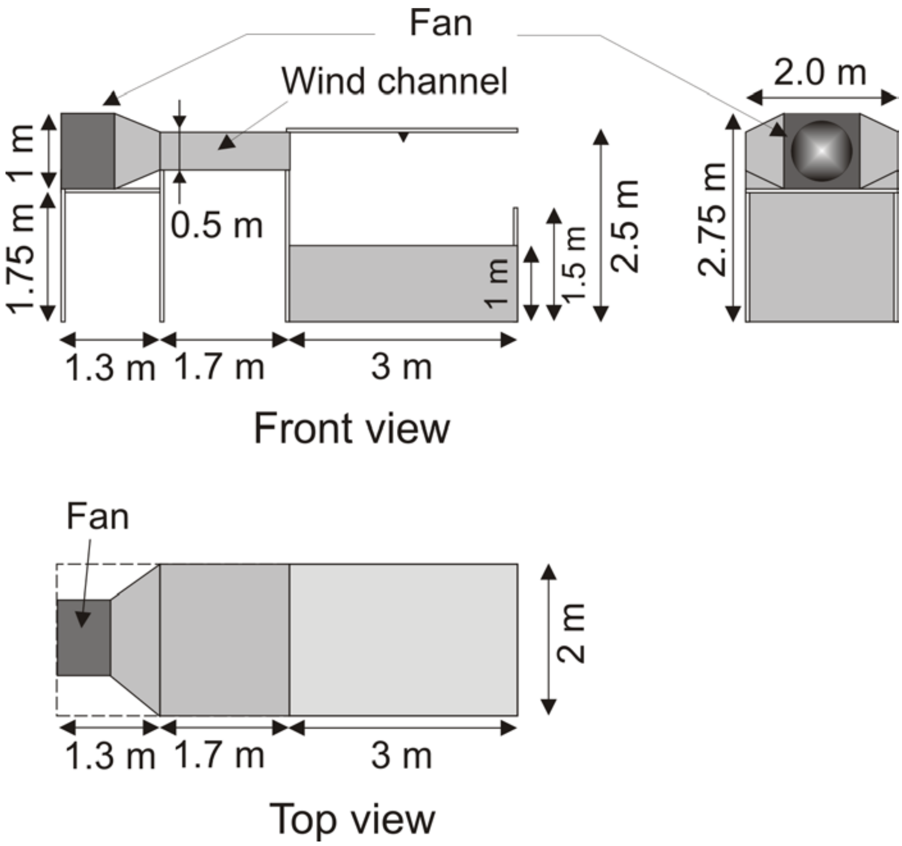


Figure 2: Chair frame

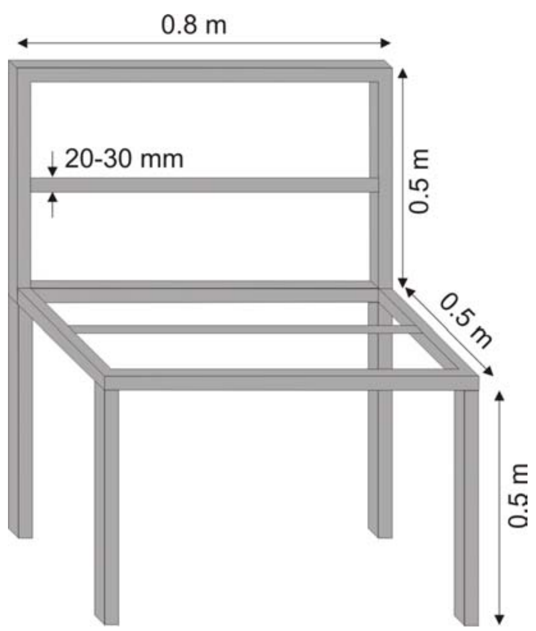


Figure 3: Fire scenario and measurements. Thermocouple locations (x) and wind measurement positions (.) for (a) ceiling nozzle, (b) sidewall nozzle

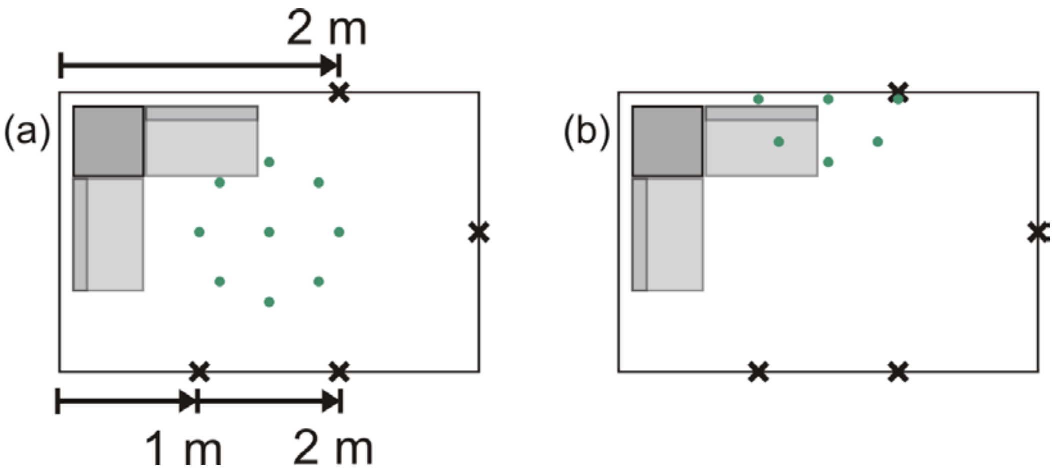
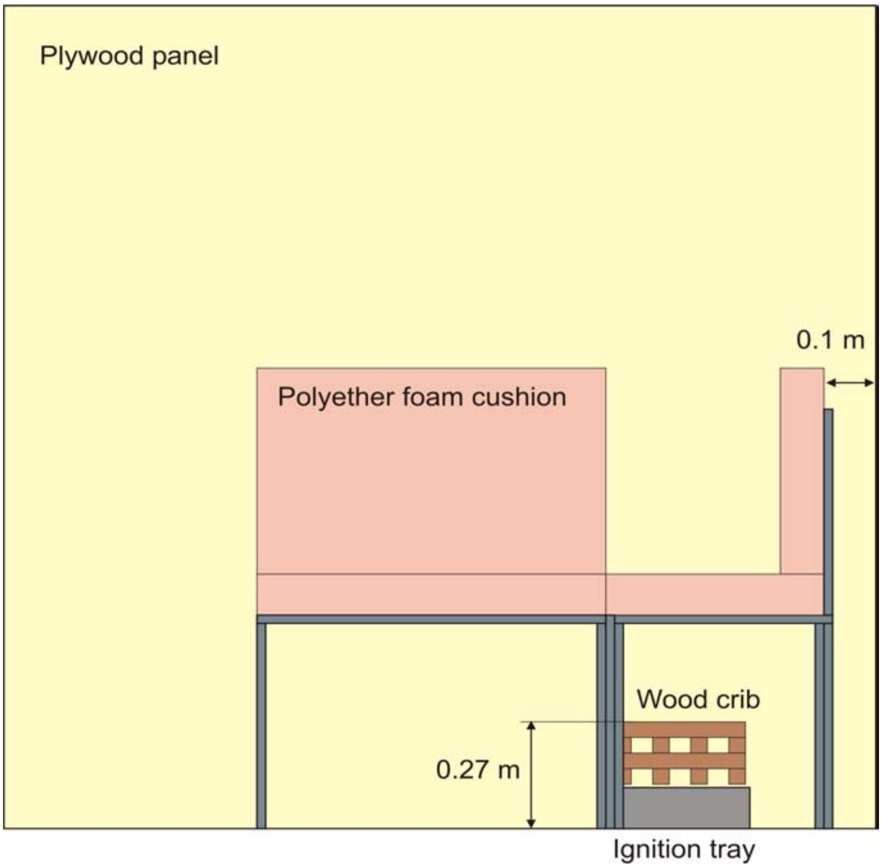


Figure 4: Fire source



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