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GUIDELINES FOR THE APPROVAL OF ALTERNATIVE FIXED WATER-BASED FIRE-FIGHTING SYSTEMS FOR SPECIAL CATEGORY SPACES

1 The Maritime Safety Committee, at its seventy-first session (19 to 28 May 1999), approved Guidelines for the approval of alternative fixed water-based fire-fighting systems for special category spaces prepared by the Sub-Committee on fire protection, at its forty-third session, as set out in the annex.

2 Member Governments are invited to apply the annexed Guidelines when approving alternative fixed water-based fire-fighting systems for use in special category spaces and inform the Organization of any technical problems identified in their implementation.

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ANNEX

GUIDELINES FOR THE APPROVAL OF ALTERNATIVE FIXED WATER-BASED FIRE-FIGHTING SYSTEMS FOR SPECIAL CATEGORY SPACES

1 General

These guidelines have been developed in recognition of the need for alternative fixed water-based fire-fighting systems in addition to the recommendation on fixed fire-extinguishing systems for special category spaces, as contained in resolution A.123(V).

2 Definitions

2.1 **Antifreeze system**: A wet pipe system employing automatic nozzles or sprinklers attached to a piping system containing an antifreeze solution and connected to a water supply. The antifreeze solution is discharged, followed by water, immediately upon operation of nozzles or sprinklers opened by heat from a fire.

2.2 **Deluge system**: A system employing open nozzles or sprinklers attached to a piping system connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the nozzles or sprinklers. When this valve opens, water flows into the piping system and discharges from all nozzles or sprinklers attached thereto.

2.3 **Dry pipe system**: A system employing automatic nozzles or sprinklers attached to a piping system containing air or nitrogen under pressure, the release of which (as from the opening of a nozzle or sprinkler) permits the water pressure to open a valve known as a dry pipe valve. The water then flows into the piping system and out of the opened sprinklers.

2.4 **Fire suppression**: A reduction in heat output from the fire and control of the fire to restrict its spread from its seat and reduce the flame area.

2.5 **Fire control:** The limitation of the growth of the fire by prewetting adjacent combustibles and controlling ceiling gas temperatures to prevent structural damage.

2.6 **Preaction system**: A system employing automatic nozzles or sprinklers attached to a piping system containing air that may or may not be under pressure, with a supplemental detection system installed in the same area as the nozzles or sprinklers. Actuation of the detection system opens a valve that permits water to flow into the piping system and to be discharged from any nozzles or sprinklers that have operated.

2.7 **Water-based extinguishing medium**: Fresh water or seawater with or without additives mixed to enhance fire-extinguishing capability.

2.8 **Wet pipe system**: A system employing automatic nozzles or sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

3 Principle requirements

3.1 The system may be automatically activated, manually activated or automatically activated with manual release capabilities.

3.2 Automatically activated systems may be of the wet pipe, dry pipe, preaction or deluge type. Manually activated systems may be of the deluge type. Automatically activated systems with manual release capabilities should be of the deluge type.

3.3 The system should be capable of fire suppression and control with confirmation testing in accordance with the appendix to these guidelines.

3.4 For wet pipe, dry pipe and preaction systems, the capacity of the water supply to the system should be based on a total simultaneous coverage of the most hydraulically demanding 280 m^2 area or four times the Area of Operation determined by the test described in the appendix to these guidelines, whichever is greatest. For deluge systems, the water supply should be based on a total simultaneous coverage of the two most hydraulically demanding adjacent sections sized in accordance with paragraph 3.5.

3.5 The system should be divided into sections which normally cover the full breadth of the vehicle deck space(s), except that in ships where the vehicle deck is subdivided with longitudinal "A" class divisions forming boundaries of staircases, etc., the breadth of the sections can be reduced accordingly. Each section should be a minimum of 20 m and a maximum of 24 m in length.

3.6 It should be possible to manually shut the section control valves from outside the protected space. Each section should be capable of being isolated by one section control valve. The section control valves should be located outside the protected space, be readily accessible and their locations should be clearly and permanently indicated. Means should be provided to prevent the operation of the section control valves by an unauthorised person.

3.7 The electrical components of the pressure source for the system should have a minimum rating of IP 54. The power supply should be provided from outside the protected space.

3.8 The system should be provided with a redundant means of pumping or otherwise supplying the water to the system. If the ship's fire main water supply has sufficient capacity (delivery rate and pressure) for use as the redundant water supply, the system may be connected to the ship's fire main by a control valve and, in addition, a non-return valve to prevent a backflow from the system.

3.9 The system should be fitted with a permanent sea inlet and be capable of continuous operation using sea water.

3.10 The system supply equipment should be located outside the protected spaces.

3.11 The system and its components should be designed to withstand ambient temperatures, vibration, humidity, shock, impact, clogging and corrosion normally encountered.

3.12 The system and its components should be designed and installed based on international standards acceptable to the Organization. The system components should be manufactured and tested based on the relevant sections of appendix A of MSC/Circ.668, as amended by MSC/Circ.728.

3.13 The nozzle location, type of nozzle and nozzle characteristics should be within the limits tested to provide fire suppression and control as referred to in paragraph 3.3. In addition, nozzles should be located to protect spaces above and below hoistable decks and ramps.

3.14 System designs should be limited to the use of the maximum and minimum temperature ratings of the thermally sensitive fire detection devices tested to provide fire suppression and control as referred to in paragraph 3.3.

3.15 Activation of the system should give a visual and audible alarm in the protected space and at a continuously manned station. The visual and audible alarms should be activated when one or more nozzles operate. An alarm in a continuously manned station should indicate the specific section of the system that is activated. The system alarm requirements described within this paragraph are in addition to, and not a substitute for, the detection and fire alarm system required by SOLAS regulation II-2/37.

3.16 A means for testing the automatic operation of the system and, in addition, assuring the required pressure and flow should be provided.

3.17 If the system is pre-primed with water containing a fire suppression enhancing additive and/or an antifreeze agent, periodic inspection and testing, as specified by the manufacturer, should be undertaken to assure that their effectiveness is being maintained.

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

3.19 Installation plans and operating manuals should be supplied to the ship and be readily available on board. A list or plan should be displayed showing spaces covered and the location of the zone in respect of each section. Instructions for testing and maintenance should be available on board.

3.20 Spare parts and operating and maintenance instructions should be provided as recommended by the manufacturer.

3.21 Where automatically operated fire-fighting systems are installed, a warning notice should be displayed outside each entry point stating the type of medium used and the possibility of automatic release.

APPENDIX

FIRE TEST METHOD FOR ALTERNATIVE FIXED WATER-BASED FIRE-FIGHTING SYSTEMS FOR SPECIAL-CATEGORY SPACES

1 Scope

1.1 This test method is intended for evaluating the effectiveness of alternative fixed water-based fire-fighting systems as compared to resolution A.123(V).

1.2 The test programme has two objectives:

.1 establishing nozzle location, nozzle characteristics, minimum water delivery rate and minimum water pressure for systems which will provide the required level of system response time, and, fire detection, suppression and control; and

.2 establishing the minimum Area of Operation of the system for the purpose of determining hydraulic design requirements for wet pipe, dry pipe and preaction systems.

2 Field of application

These tests are applicable to systems installed in special category spaces with deck heights equal to, or greater than, 2.4 m.

3 General requirements

3.1 Sampling

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

3.2 Tolerances

Unless otherwise stated, the following tolerances should apply:

.1	Length	±2% of value
.2	Volume	±5% of value
.3	Pressure	±3% of value
.4	Temperature	±2% of value

3.3 Observations

The following observations should be made during and after each test:

.1 Time of ignition.
.2 Activation time of first nozzle.
.3 Time when water flows out through first nozzle.
.4 Time when water flow is shut off.

.5 Time when the test is terminated.
.6 Total number of activated nozzles.

3.4 Test hall and environmental conditions

The test hall where the tests are conducted should have a minimum floor area of 300 m^2 and a ceiling height in excess of 8 m. The test hall may be equipped with a forced ventilation system, or be natural ventilated, in order to ensure that there is no restriction in air supply to the test fires. The test hall should have an ambient temperature of between 10°C and 30°C at the start of each test.

3.5 Measurement equipment

Temperatures should be measured using a Plate Thermometer similar to that described in the references below[1]. The instrument consists of a 0.7 mm thick Inconel 600 steel plate, 100 mm by 100 mm square. It is insulated on the back by a 10 mm thick ceramic fibre pad. Other types of measurement equipment are allowed, if it is proven that they provide similar temperature versus time results.

System water pressure and total water flow rate should be measured by using suitable equipment.

3.6 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 and/or antifreeze agent, if applicable, should be taken into account.

4 Determination of fire suppression and control capabilities

4.1 Principle

This test procedure tests the effectiveness of a water-based fire-fighting system against a combination of a pool fire and a cargo fire in two simulated freight trucks. At least two tests should be conducted at the minimum and the maximum ceiling to nozzle distance limitations, specified by the manufacturer.

4.2 Fire sources

The primary fire sources consist of:

.1 a flammable liquid pool fire;

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[1] **References**

[1] Wickström, Ulf, "The plate thermometer - A simple instrument for reaching harmonized fire resistance tests", SP-REPORT 1989:03, Swedish National Testing and Research Institute, Borås, 1989

[2] Wickström, Ulf, "The plate thermometer - A simple instrument for reaching harmonized fire resistance tests", Fire Technology, Volume 30, No. 2, 1994

.2 plastic commodity cardboard cartons; and

.3 a non-fire retardant tarpaulin.

4.2.1 N-Heptane should be used as the flammable liquid.

4.2.2 A cartoned plastic commodity should be used for the cargo of the simulated freight trucks. An acceptable commodity is either the EUR Std Plastic or the FMRC Std Plastic. These commodities consist of empty polystyrene cups without lids, placed upside down, in compartmented cartons. Details of the commodities are given in table 4.2.2.

Table 4.2.2
Details of specified plastic commodities

Designation	Nominal size of individual carton (L x W x H) (mm)	Number of cups
EUR Std Plastic	600 x 400 x 500	120
FMRC Std Plastic	530 x 530 x 500	125

The corrugated cartons, partitions and pads for packaging the cups should be non-fire retardant, have a "C" flute configuration and be plain printed.

4.2.3 The tarpaulin used to cover the simulated freight trucks should be made from non-fire retardant Polyester having a nominal area weight of 600±50 g/m^2.

4.3 Apparatus

4.3.1 Test area

The tests should be conducted in a test hall as specified in paragraph 3.4 under a flat, smooth, non-combustible ceiling of at least 100 m^2.

4.3.2 Simulated freight trucks

Two simulated freight trucks should be constructed using steel racks (see figures 4.3.2-1 through 3). The racks should have an overall length of 5.8 m, an overall width of 2.4 m and be placed side by side, 0.6±0.05 m apart. The overall height of the simulated freight trucks should be 4.5±0.05 m. At 1.2±0.05 m above the floor, a bottom should be built in each of the racks. The bottom should be built of nominally 2 mm thick steel plates.

Horizontal steel beams on the sides facing the flue space of the racks should be used to prevent the cartons from falling over. The beams should be 0.08 ±0.02 m in height and be spaced approximately 0.5 m vertically apart. The top beam should be positioned at the level of the top of the stacks of cartons described in 4.3.3.

Around the bottom of the perimeter of the racks, tailgates should be built. The tailgates should be 0.6 m high and be constructed from nominally 12 mm thick non-combustible fibre boards.

Nominally 50 mm by 50 mm crossbeams should be installed perpendicular to the long side, at the top of each of the two racks. The crossbeams should be made from wood and spaced approximately 0.6 m apart.

The sides and the top of the two racks should be fully covered with a tarpaulin as specified in paragraph 4.2.3. The tarpaulin should be stapled to the tailgates all around the simulated freight trucks and to both ends of each of the nine wooden crossbeams.

4.3.3 The cargo of the simulated freight trucks

Three stacks of cardboard cartons should be located on each of the simulated freight trucks. The central stack should consist of plastic commodity cardboard cartons, the outer two stacks should consist of cardboard cartons without plastic cups (with internal divisions only). All stacks should be placed on conventional wood pallets. Spacers made of a suitable non-combustible material should be used under the pallets to provide for a vertical distance between the top of the stacks and the top of the simulated freight trucks of 0.5±0.05 m.

If the EUR Std Plastic commodity cartons are used, each of the carton stacks should consist of 60 cartons, and have an overall dimension of 1.6 m by 1.8 m by 2.5 m (height).

If the FMRC Std Plastic commodity cartons are used, each of the carton stacks should consist of 45 cartons, and have an overall dimension of 1.6 m by 1.6 m by 2.5 m (height).

All outer columns of cartons should be stapled together at all rows to prevent the stacks from falling over.

The distance between the carton stacks and the flue space, as well as between the individual carton stacks should be 0.3±0.05 m.

4.3.4 Target arrays

Two target arrays, with an overall length of 8.0 m, made from the tarpaulin as specified in paragraph 4.2.3, should be installed at the same overall height of the simulated freight trucks. The tarpaulin should be attached, using staples, to a wood framework so that a 1 m wide horizontal and a 3.3 m high vertical area is formed. Behind each of the target tarpaulins should be a single row of empty cardboard cartons as defined in paragraph 4.2.2, which are located continuously along the target array. The cardboard cartons should be supported along their bottom as well as along their outside surfaces to prevent them from falling over during the fire test. See figures 4.3.2-2, 4.3.2-3 and 4.3.4.

4.3.5 Pool fire tray

A nominally 2 m long by 1.5 m wide by 2 mm thick steel tray should be positioned centrically under the simulated freight trucks as shown in figure 4.3.2-3. The tray should have a 100 mm rim height. Means should be provided to prevent overflowing of the tray.

4.4 Nozzle positioning

Nozzles should be installed in an array above the simulated freight trucks in accordance with the manufacturer's design and installation criteria. However, nozzles along the centreline between the simulated freight trucks are not permitted to be installed closer to the centre point of the pool fire tray than half the nozzle spacing.

4.5 Instrumentation

Instrumentation for the continuous measuring and recording of test conditions should be employed. The following measurements should be made:

.1 The temperature flush with the ceiling at three positions. See figure 5.
.2 The temperature at 0.08±0.02 m underneath the bottom of the simulated freight trucks, at two positions. See figure 4.5.
.3 System water pressure near the centre of the piping array.
.4 The total water flow rate of the system.

Note: Additional ceiling temperature measurement positions should be used if it is suspected that other positions are being exposed to higher temperatures.

4.6 Test programme and test procedure

4.6.1 Test programme

Tests should be conducted at the minimum system water pressure, minimum and maximum ceiling heights as well as at the minimum and maximum distance between the lowest part of the nozzles and the ceiling, as specified by the manufacturer. The minimum ceiling height should not to be less than 4.8 m.

4.6.2 Test procedure

The test procedure should be applied as follows:

.1 The water pressure used at the start of the test should be set at the minimum value for the system specified by the manufacturer, flowing six open nozzles. If more than six nozzles operate during the test, the water supply pressure should be adjusted accordingly, to keep the required minimum system water pressure.

.2 The tray should be filled with 10 mm (30 L) of n-Heptane on a 10 mm water base.

.3 The measurements are started.

.4 The flammable liquid pool fire should be lit by means of a torch or a match.

.5 The fire should be allowed to burn for a period of 10 minutes or until is it clear that any of the acceptance criteria has failed.

.6 Any remaining fire should be manually extinguished.

.7 The test is terminated.

4.7 Acceptance criteria

The following three criteria should be met:

.1 The temperature measured underneath the simulated freight trucks at either measurement position should be reduced to below 500°C no later than three minutes after ignition and to below 300°C no later than four minutes after ignition.

.2 The cardboard cartons in the target arrays should not ignite.

.3 The maximum five minute average ceiling surface temperature at any measurement position should not exceed 600°C.

5 Determination of area of operation

5.1 Principle

The test procedure described in this section is intended to establish the Area of Operation of wet pipe, dry pipe and preaction systems.

5.2 Apparatus

5.2.1 Test area

The tests should be conducted in a test hall as specified in paragraph 3.4 under a flat, smooth, non-combustible ceiling. The ceiling area should be large enough to allow installation of enough nozzles to fulfill the requirements of paragraph 5.6.

5.2.2 Pool fire trays

The fire source should consist of a large open pool fire with n-Heptane. Four nominally 1.25 m long by 1.25 m wide by 2 mm thick steel trays should be positioned abutting each other and forming a square pool area totalling 6.25 m^2. The trays should have a 100 mm rim height. The centre point of the pool should be centrally positioned below four nozzles. The intention is to not use any other fire source.

5.3 Nozzle positioning

The type of nozzle, installed at the spacing and the orientation proven to meet the requirements of paragraph 4.7 should be installed. Enough nozzles should be installed to fulfill the requirements of paragraph 5.6.

5.4 Instrumentation

Instrumentation for the continuous measurement and recording of test conditions should be employed. The following measurements should be made:

.1 System water pressure near the centre of the piping array.

.2 The total water flow rate of the system.

5.5 Test programme and test procedure

5.5.1 Test programme

Tests should be conducted at the minimum system water pressure, minimum and maximum ceiling heights as well as at the minimum and maximum distance between the lowest part of the nozzles and the ceiling, as specified by the manufacturer. The minimum ceiling height should not to be less than 4.8 m.

5.5.2 Test procedure

The test procedure should be applied as follows:

.1 The water pressure used at the start of the test should be set at the minimum value for the system specified by the manufacturer, flowing six open nozzles. If more than six nozzles operate during the test, the water supply pressure should be adjusted accordingly, to keep the required minimum system water pressure.

.2 Each of the trays should be filled with 5 mm (8 L) of n-Heptane on a 10 mm (16 L) water base.

.3 The measurements are started.

.4 The flammable liquid pool fire should be lit by means of a torch or a match.

.5 The fire should be allowed to burn until all flammable liquid is consumed.

.6 The test is terminated.

5.6 Acceptance criteria

The following two criteria should be met:

.1 The outermost nozzles in any direction from the centre point of the pool fire trays should not be allowed to operate.

.2 No nozzle should operate further away than on a 10 m radius from the centre point of the pool fire trays.

5.7 Determination of area of operation

The area of operation should be determined by multiplying the maximum number of nozzles that operated in the tests as specified in paragraph 5.5.1 by the coverage area of the individual nozzles.

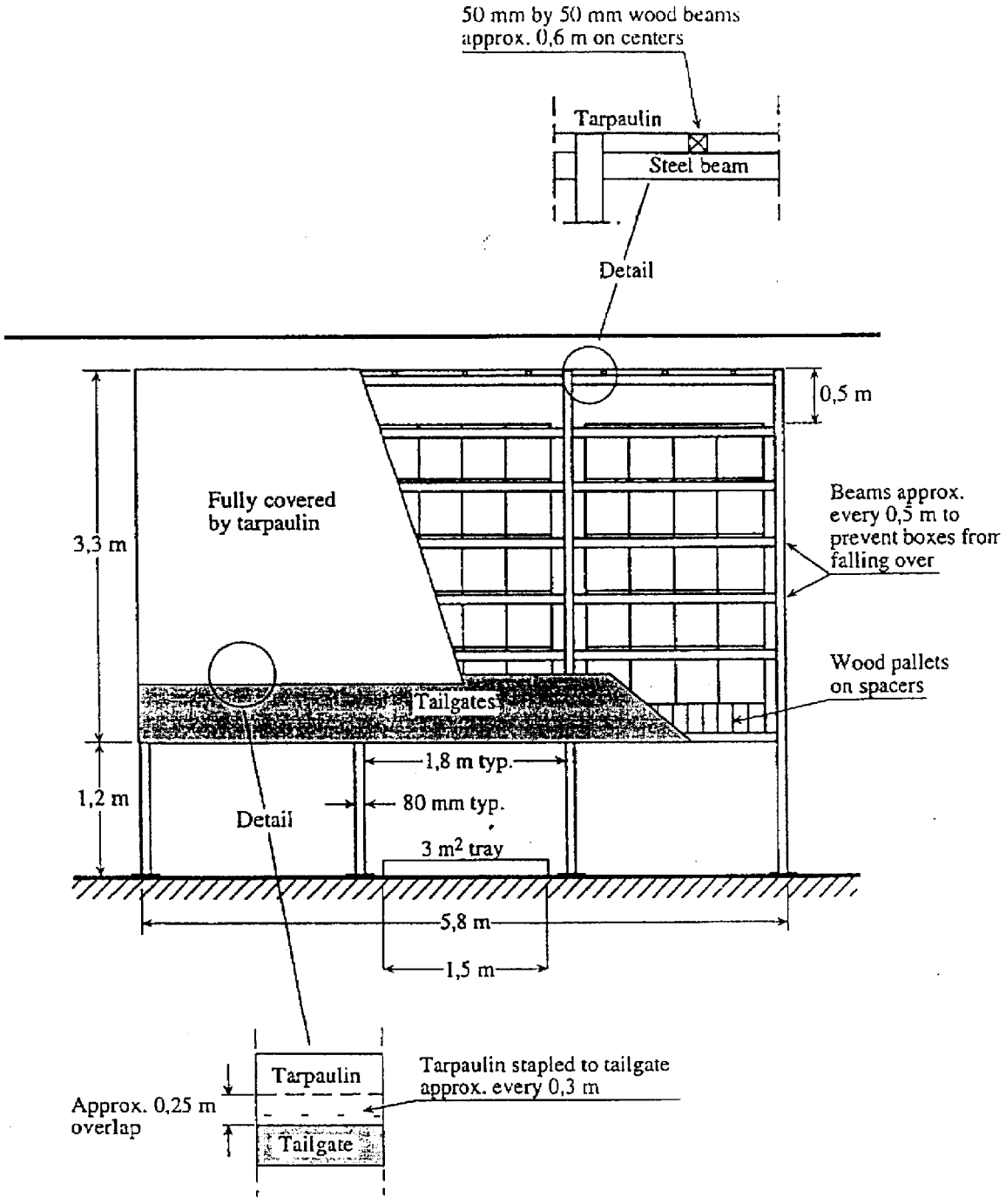
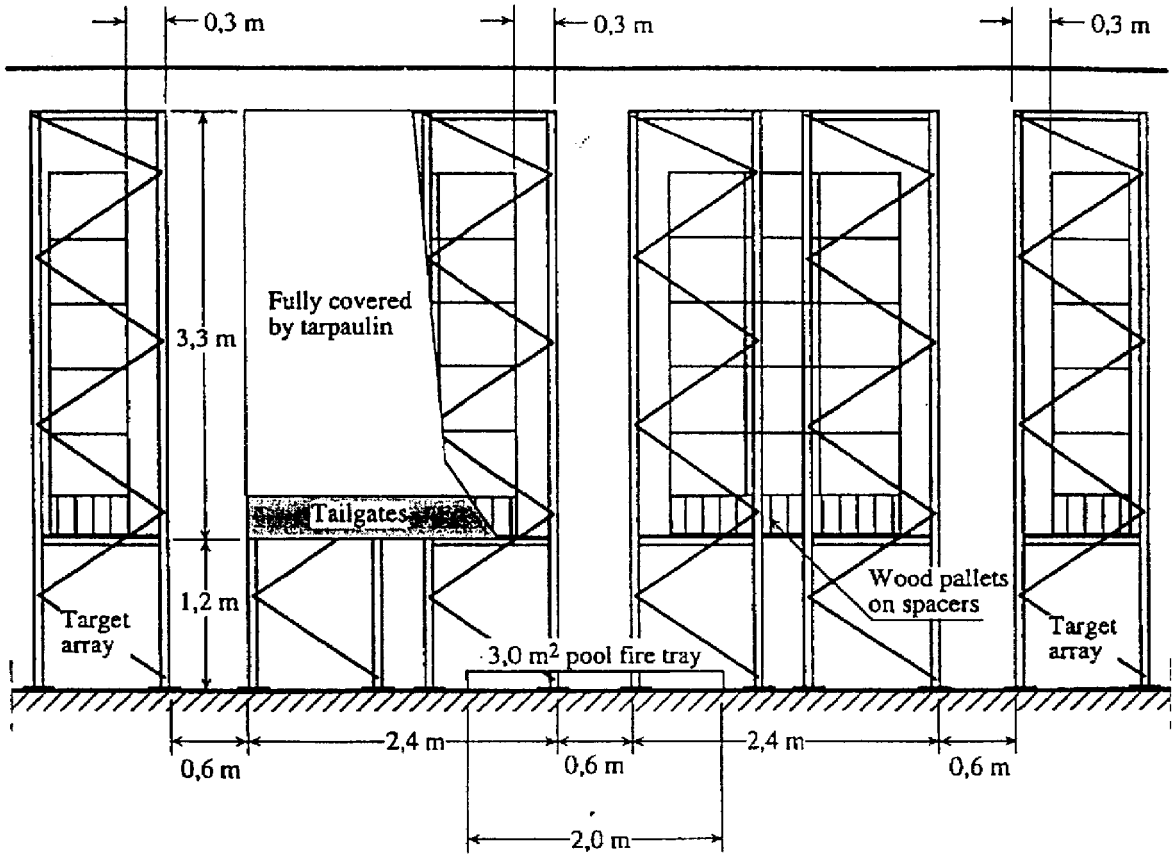
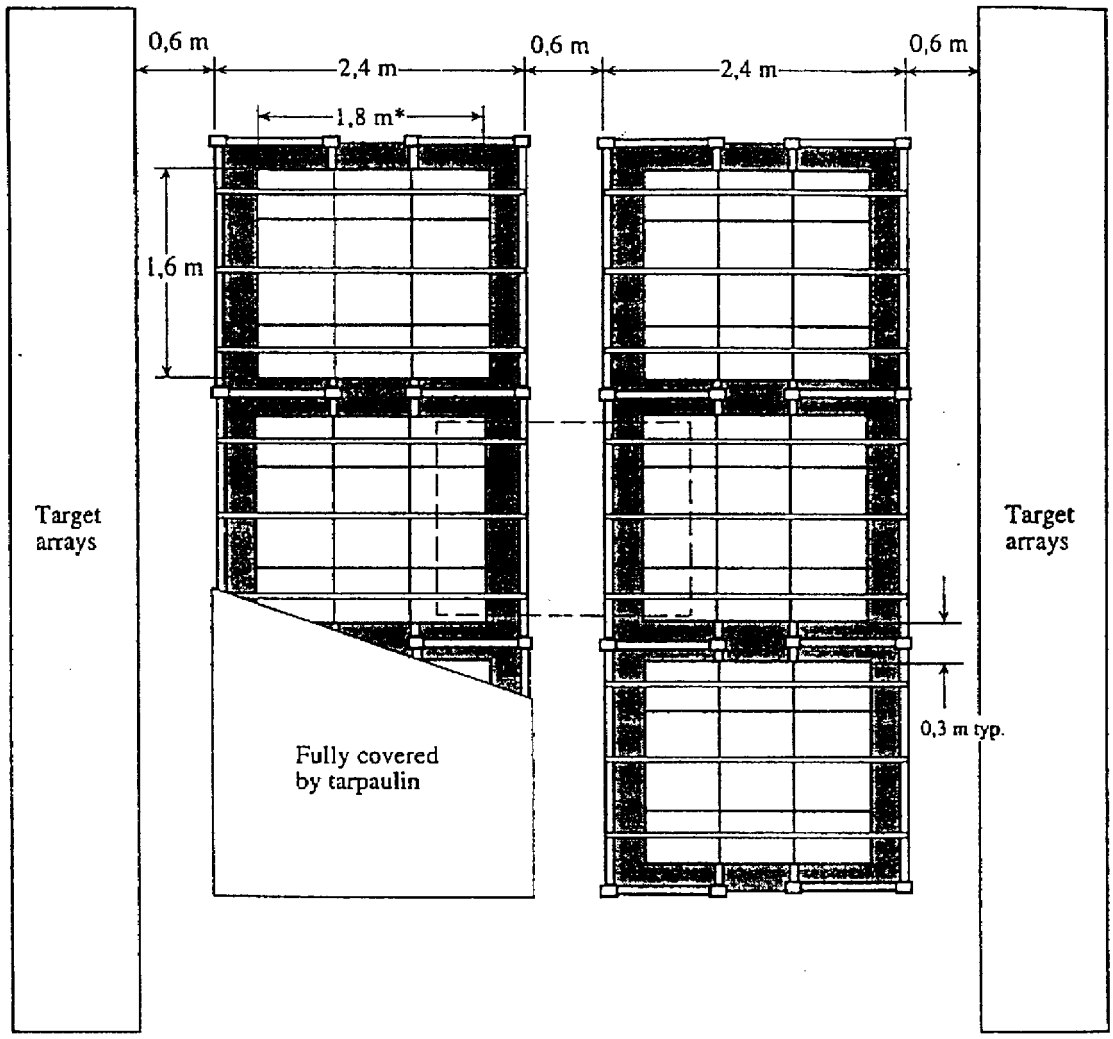

50 mm by 50 mm wood beams
approx. 0,6 m on centers
Tarpaulin
Steel beam
Detail
0,5 m
Fully covered
by tarpaulin
3,3 m
Beams approx.
every 0,5 m to
prevent boxes from
falling over
Wood pallets
on spacers
Tailgates
1,8 m typ.
1,2 m
Detail
80 mm typ.
3 m2 tray
5,8 m
1,5 m
Tarpaulin
Tarpaulin stapled to tailgate
approx. every 0,3 m
Approx. 0,25 m
overlap
Tailgate
Drawing is shown with EUR Std Plastic sized cartons

Figure 4.3.2-1



Drawing is shown with EUR Std Plastic sized cartons

Figure 4.3.2-2



Drawing is shown with EUR Std Plastic sized cartons.
* Should be 1.6 m if FMRC Std Plastic is used.
See details of targets in figure 4.

Figure 4.3.2-3

Details of the target arrays

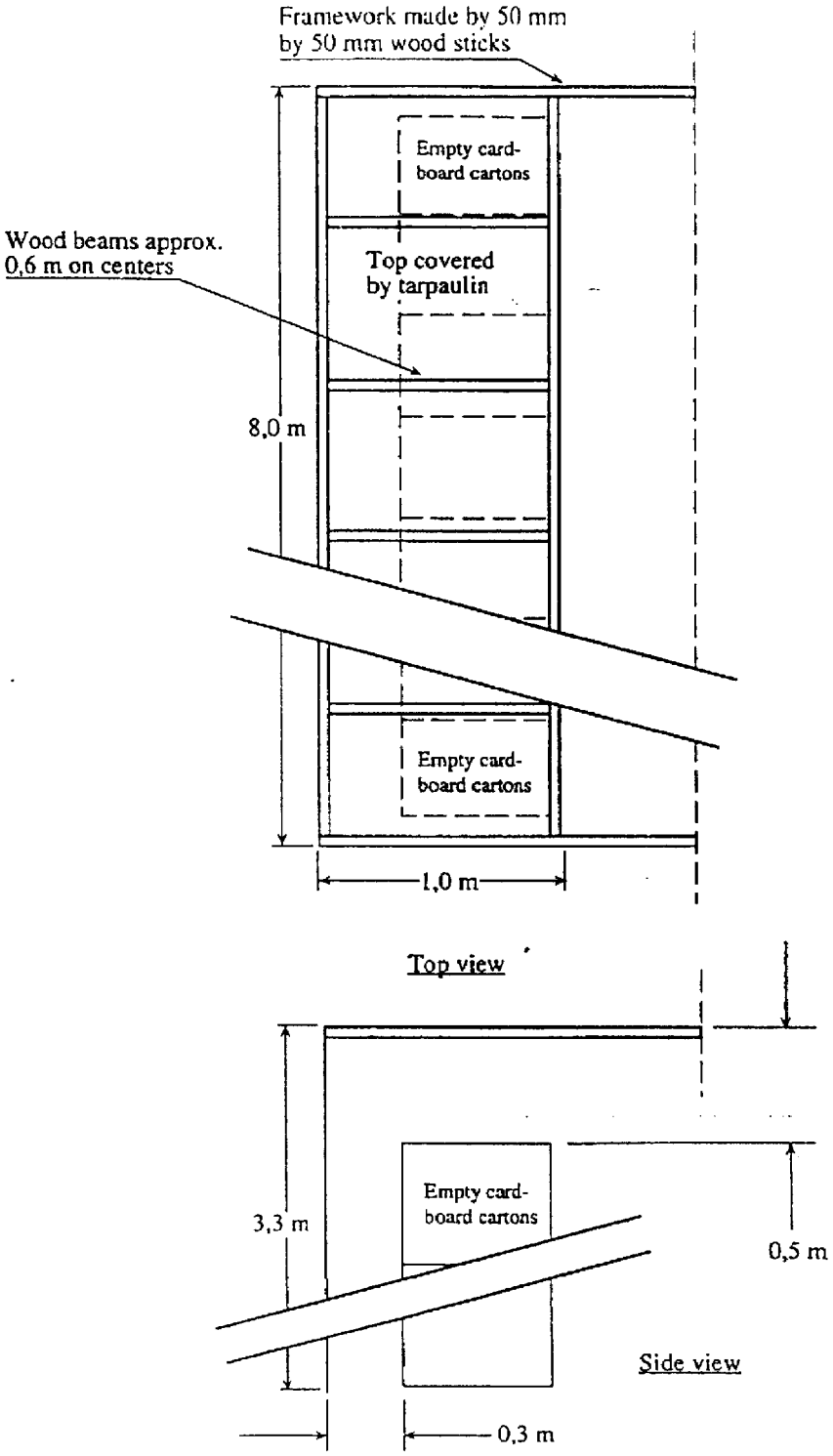


Figure 4.3.4

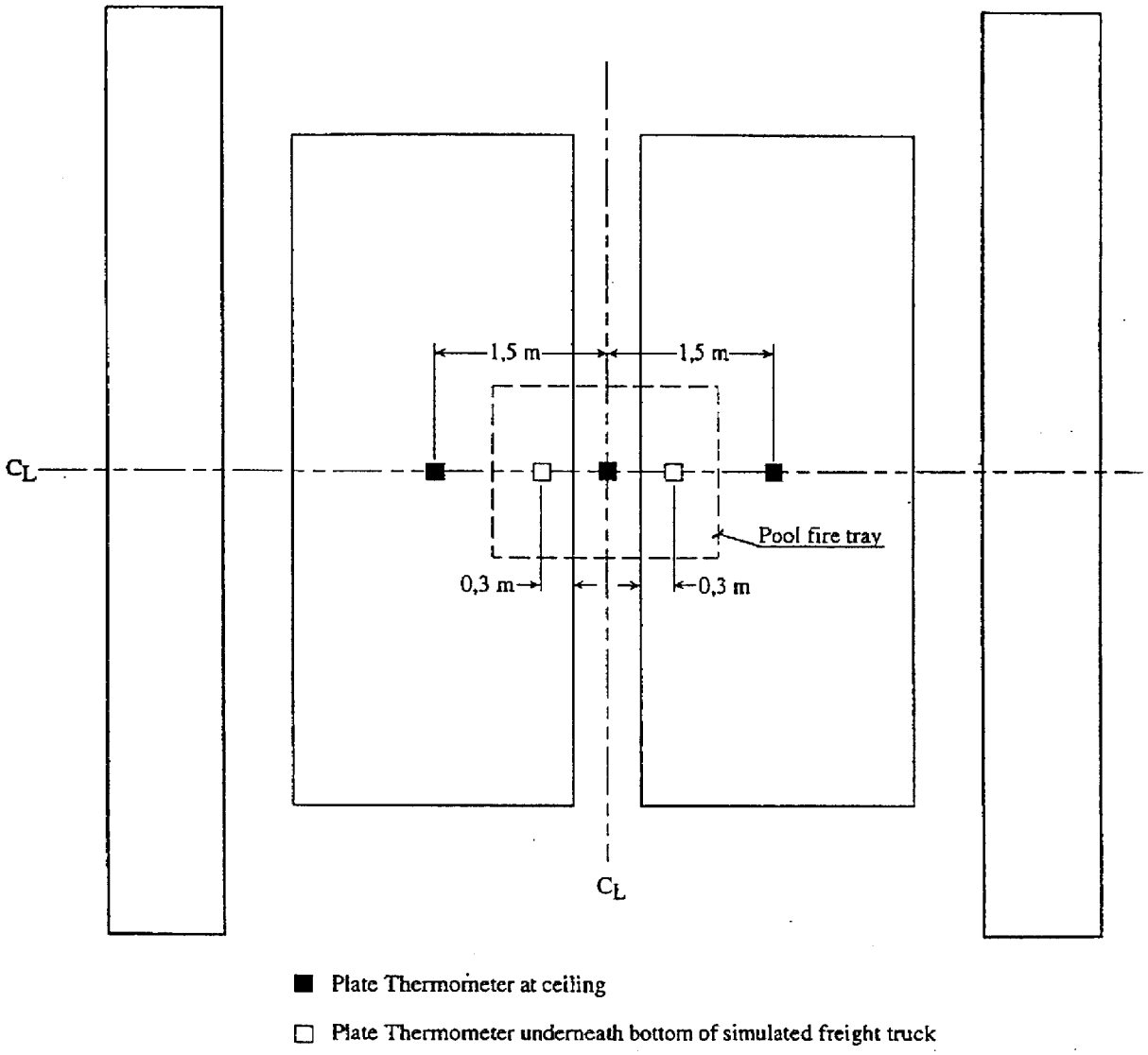

1,5 m
1,5 m
C_L
Pool fire tray
0,3 m
0,3 m
C_L
Plate Thermometer at ceiling
Plate Thermometer underneath bottom of simulated freight truck

Figure 4.5