



Ref.: T4/4.01

MSC.1/Circ.1270
4 June 2008

**REVISED GUIDELINES FOR THE APPROVAL OF FIXED AEROSOL
FIRE-EXTINGUISHING SYSTEMS EQUIVALENT TO FIXED GAS
FIRE-EXTINGUISHING SYSTEMS, AS REFERRED TO IN SOLAS 74,
FOR MACHINERY SPACES**

- 1 The Maritime Safety Committee, at its seventy-fourth session (30 May to 8 June 2001), approved the Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces (MSC/Circ.1007).
- 2 The Sub-Committee on Fire Protection, at its fifty-second session (14 to 18 January 2008), reviewed the Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces (MSC/Circ.1007) and revised the Guidelines.
- 3 The Committee, at its eighty-fourth session (7 to 16 May 2008), after having considered the above proposal, approved the Revised Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces, as set out in the annex.
- 4 Member Governments are invited to apply the Revised Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces on and after 9 May 2008 and bring them to the attention of ship designers, ship owners, equipment manufacturers, test laboratories and other parties concerned.
- 5 This circular supersedes circular MSC/Circ.1007.

ANNEX

REVISED GUIDELINES FOR THE APPROVAL OF FIXED AEROSOL FIRE-EXTINGUISHING SYSTEMS EQUIVALENT TO FIXED GAS FIRE-EXTINGUISHING SYSTEMS, AS REFERRED TO IN SOLAS 74, FOR MACHINERY SPACES

General

1 Fixed aerosol fire-extinguishing systems for use in machinery spaces of category A equivalent to fire-extinguishing systems required by SOLAS regulation II-2/10.5 should prove that they have the same reliability which has been identified as significant for the performance of fixed gas fire-extinguishing systems approved under the requirements of the International Code for Fire Safety Systems (FSS Code), chapter 5. In addition, the system should be shown, by testing according to appendix 1 to these Guidelines, to have the capability of extinguishing a variety of fires that can occur in machinery spaces.

2 Aerosol fire-extinguishing systems involve the release of a chemical agent to extinguish a fire by interruption of the process of the fire.

There are two methods considered for applying the aerosol agent to the protected space:

- .1 condensed aerosols are created in pyrotechnical generators through the combustion of the agent charge; and
- .2 dispersed aerosols that are not pyrotechnically generated and are stored in containers with carrier agents (such as inert gases or halocarbon agents) with the aerosol released in the space through valves, pipes and nozzles.

Definitions

3 *Aerosol* is a fire-extinguishing medium consisting of finely divided solid particles of chemicals released into a protected space as either condensed aerosol or dispersed aerosol.

4 *Generator* is a device for creating a fire-extinguishing medium by pyrotechnical means.

5 *Efficiency coefficient* is the percentage (%) of aerosol forming composition actually discharged from a specific aerosol generator. It is determined by comparing the mass loss of a generator after discharge to its beginning mass.

6 *Design application density (g/m^3)* is the mass of an aerosol forming composition per m^3 of the enclosure volume required to extinguish a specific type of fire, including a safety factor of 1.3 times the test density.

7 *Agent – medium* for the purpose of these guidelines, these words are interchangeable.

Principal requirements

8 The design application density should be determined and verified by the full-scale testing described in the test method, as set out in appendix 1.

9 The delivered density for each type of generator should be determined and verified by the test method set out in appendix 2.

10 The system discharge time should not exceed 120 s. Systems may need to discharge in a shorter time for other reasons than for fire-extinguishing performance.

11 The quantity of extinguishing agent for the protected space should be calculated at the minimum expected ambient temperature using the design density based on the net volume of the protected space, including the casing.

11.1 The net volume of a protected space is that part of the gross volume of the space, which is accessible to the fire-extinguishing agent.

11.2 When calculating the net volume of a protected space, the net volume should include the volume of the bilge, the volume of the casing and the volume of free air contained in air receivers that in the event of a fire may be released into the protected space.

11.3 The objects that occupy volume in the protected space should be subtracted from the gross volume of the space. They include, but are not necessarily limited to:

- .1 auxiliary machinery;
- .2 boilers;
- .3 condensers;
- .4 evaporators;
- .5 main engines;
- .6 reduction gears;
- .7 tanks; and
- .8 trunks.

11.4 Subsequent modifications to the protected space that alter the net volume of the space should require the quantity of extinguishing agent to be adjusted to meet the requirements of this paragraph and paragraphs 10.1, 10.2, 10.3, 10.4, 12.2, 12.3, 12.4 and 12.5.

12 No fire suppression system should be used which is carcinogenic, mutagenic or teratogenic at application densities expected during use. The discharge of aerosol systems to extinguish a fire could create a hazard to personnel from the natural form of the aerosol, or from certain products of aerosol generation (including combustion products and trace gases from condensed aerosols).

Other potential hazards that should be considered for individual systems are the following: noise from discharge, turbulence, cold temperature of vaporizing liquid, reduced visibility, potential toxicity, thermal hazard and potential toxicity from the aerosol generators, and eye irritation from direct contact with aerosol particles. Unnecessary exposure to aerosol media, even at concentrations below an adverse effect level, and to their decomposition products should be avoided. All aerosols used in fire-extinguishing systems should have non-ozone depleting characteristics.

12.1 All systems should be designed to allow evacuation of the protected spaces prior to discharge through the use of two separate controls for releasing the extinguishing medium. Means should also be provided for automatically giving visual and audible warning of the release of fire-extinguishing medium into any space in which personnel normally work or to which they have access. The alarms should operate for the period of time necessary to evacuate the space, but not less than 20 s before the medium is released.

12.2 Condensed aerosol systems for spaces that are normally occupied should be permitted in concentrations where the aerosol particulate density does not exceed the adverse effect level as determined by a scientifically accepted technique* and any combustion products and trace gases produced by the aerosol generating reaction do not exceed the appropriate excursion limit for the critical toxic effect as determined in acute inhalation toxicity tests.

12.3 Dispersed aerosol systems for spaces that are normally occupied should be permitted in concentrations where the aerosol particulate density does not exceed the adverse effect level as determined by a scientifically accepted technique. Even at concentrations below an adverse affect level, exposure to extinguishing agents should not exceed 5 min. If the carrier gas is a halocarbon, it may be used up to its No Observed Adverse Affect Level (NOAEL) calculated on the net volume of the protected space at the maximum expected ambient temperature without additional safety measures. If a halocarbon carrier gas is to be used above its NOAEL, means should be provided to limit exposure to no longer than the corresponding maximum permitted human exposure time specified according to a scientifically accepted physiologically based pharmacokinetic** (PBPK) model or its equivalent which clearly establishes safe exposure limits both in terms of extinguishing media concentration and human exposure time.

12.4 If the carrier is an inert gas, means should be provided to limit exposure to no longer than 5 min for inert gas systems designed to concentrations below 43% (corresponding to an oxygen concentration of 12%, sea level equivalent of oxygen) or to limit exposure to no longer than 3 min for inert gas systems designed to concentrations between 43% and 52% (corresponding to between 12% and 10% oxygen, sea level equivalent of oxygen) calculated on the net volume of the protected space at the maximum expected ambient temperature.

12.5 In no case should a dispersed aerosol system be used with halocarbon carrier gas concentrations above the Lowest Observed Adverse Effect Level (LOAEL) nor the Approximate Lethal Concentration (ALC) nor should a dispersed aerosol system be used with an inert gas carrier at gas concentrations above 52% calculated on the net volume of the protected space at the maximum expected ambient temperature.

* Reference is made to the United States' EPAs Regional Deposited Dose Ratio Program "Methods of Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry" EPA/600/8-90/066F, October 1994.

** Refer to document FP 44/INF.2 (United States) – Physiologically based pharmacokinetic model to establish safe exposure criteria for halocarbon fire-extinguishing agents.

13 The system and its components should be suitably designed to withstand ambient temperature changes, vibration, humidity, shock, impact, clogging, electromagnetic compatibility and corrosion normally encountered in machinery spaces. Generators in condensed aerosol systems should be designed to prevent self-activation at a temperature below 250°C.

14 The system and its components should be designed, manufactured and installed in accordance with standards acceptable to the Organization. As a minimum, the design and installation standards should cover the following elements:

- .1 safety:
 - .1 toxicity;
 - .2 noise, generator/nozzle discharge;
 - .3 decomposition products;
 - .4 obscuration; and
 - .5 minimum safe distance required between generators and escape routes and combustible materials;
- .2 storage container design and arrangement:
 - .1 strength requirements;
 - .2 maximum/minimum fill density, operating temperature range;
 - .3 pressure and weight indication;
 - .4 pressure relief; and
 - .5 agent identification, production date, installation date and hazard classification;
- .3 agent supply, quantity, quality standards, shelf life and service life of agent and igniter;
- .4 handling and disposal of generator after service life;
- .5 pipes and fittings:
 - .1 strength, material properties, fire resistance; and
 - .2 cleaning requirements;

- .6 valves:
 - .1 testing requirements; and
 - .2 elastomer compatibility;
- .7 generators/nozzles:
 - .1 height and area testing requirements;
 - .2 elevated temperature resistance; and
 - .3 mounting location requirements considering safe distances to escape routes and combustible materials;
- .8 actuation and control systems:
 - .1 testing requirements; and
 - .2 backup power requirements;
- .9 alarms and indicators:
 - .1 predischARGE alarm, agent discharge alarms and time delays;
 - .2 supervisory circuit requirements;
 - .3 warning signs, audible and visual alarms; and
 - .4 annunciation of faults;
- .10 enclosure integrity and leakage requirements:
 - .1 enclosure leakage;
 - .2 openings; and
 - .3 mechanical ventilation interlocks;
- .11 electrical circuits for pyrotechnic generators:
 - .1 requirements for mounting and protection of cables;
- .12 design density requirements, total flooding quantity;

- .13 agent flow calculation:
 - .1 verification and approval of design calculation method;
 - .2 fitting losses and/or equivalent length; and
 - .3 discharge time;
 - .14 inspection, maintenance, service and testing requirements; and
 - .15 handling and storage requirements for pyrotechnical components.
- 15 The generator/nozzle type, maximum generator/nozzle spacing, maximum generator/nozzle installation height and minimum generator/nozzle pressure should be within limits tested.
- 16 Installations should be limited to the maximum volume tested.
- 17 Where agent containers are stored within a protected space, the containers should be evenly distributed throughout the space and meet the following provisions:
- .1 a manually initiated power release, located outside the protected space, should be provided. Duplicate sources of power should be provided for this release and should be located outside the protected space and be immediately available;
 - .2 electric power circuits connecting the generators should be monitored for fault conditions and loss of power. Visual and audible alarms should be provided to indicate this;
 - .3 pneumatic, electric or hydraulic power circuits connecting the generators should be duplicated and widely separated. The sources of pneumatic or hydraulic pressure should be monitored for loss of pressure. Visual and audible alarms should be provided to indicate this;
 - .4 within the protected space, electrical circuits essential for the release of the system should be fire resistant according to standard IEC 60331 or equivalent standards. Piping systems essential for the release of systems designed to be operated hydraulically or pneumatically should be of steel or other equivalent heat-resisting material to the satisfaction of the Administration;
 - .5 each dispersed aerosol pressure container should be fitted with an automatic overpressure release device which, in the event of the container being exposed to the effects of fire and the system not being operated, will safely vent the contents of the container into the protected space;
 - .6 the arrangement of generators and the electrical circuits and piping essential for the release of any system should be such that in the event of damage to any one power release line or generator through mechanical damage, fire or explosion in a protected space, i.e., a single fault concept, at least the amount of agent needed to

achieve the test density can still be discharged having regard to the requirement for uniform distribution of medium throughout the space; and

- .7 dispersed aerosol containers should be monitored for decrease in pressure due to leakage and discharge. Visual and audible alarms in the protected area and on the navigation bridge, in the onboard safety centre or in the space where the fire control equipment is centralized should be provided to indicate this condition.

18 The release of an extinguishing agent may produce significant over and under pressurization in the protected space. Constructive measures to limit the induced pressures to acceptable limits may have to be provided.

19 For all ships, the fire-extinguishing system design manual should address recommended procedures for the control and disposal of products of agent decomposition. The performance of fire-extinguishing arrangements on passenger ships should not present health hazards from decomposed extinguishing agents, (e.g., on passenger ships, the decomposition products should not be discharged in the vicinity of assembly stations).

20 Spare parts and operating and maintenance instructions, including operational tests for the system should be provided as recommended by the manufacturer.

21 The temperature profile of the discharge stream from condensed aerosol generators should be measured in accordance with appendix 1. This data should be used to establish the minimum safe distances away from the generator where the discharge temperatures do not exceed 75°C and 200°C.

22 The casing temperature of condensed aerosol generators should be measured in accordance with appendix 1. This data should be used to establish the minimum safe distances away from the generator where the discharge temperatures do not exceed 75°C and 200°C.

23 Generators should be separated from escape routes and other areas where personnel may be present by at least the minimum safe distances determined in paragraphs 21 and 22 above for exposure to 75°C.

24 Generators should be separated from combustible materials by at least the minimum safe distances determined in paragraphs 21 and 22 above for exposure to 200°C.

25 The useful life of condensed aerosol generators should be determined by the manufacturer for the temperature range and conditions likely to be encountered on board ships. Generators should be replaced before the end of their useful life. Each generator should be permanently marked with the date of manufacture and the date of mandatory replacement.

APPENDIX 1

TEST METHOD FOR FIRE TESTING OF FIXED AEROSOL FIRE-EXTINGUISHING SYSTEMS

1 SCOPE

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

1.2 The test method is applicable to aerosols and covers the minimum requirements for fire-extinguishing.

1.3 The test programme has two objectives:

- .1 establishing the extinguishing effectiveness of a given agent at its tested concentration; 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 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 METHOD OF TEST

3.1 Principle

This test procedure is intended for the determination of the effectiveness of different aerosol agent extinguishing systems against spray fires, pool fires and class A fires. It also establishes the minimum safe distances from condensed aerosol generators to personnel and combustible materials.

3.2 Apparatus

3.2.1 *Test room*

The tests should be performed in 100 m² room, with no horizontal dimension less than 8 m, with a ceiling height of 5 m. The test room should be provided with a closable access door measuring approximately 4 m² in area. In addition, closable ventilation hatches measuring at least 6 m² in total area should be located in the ceiling. A larger room may be employed if approvals are sought for larger volumes.

3.2.2 *Integrity of test enclosure*

The test enclosure should be nominally leaktight when doors and hatches are closed. The integrity of seals on doors, hatches and other penetrations (e.g., instrumentation access ports) should be verified before each test.

3.2.3 *Engine mock-up*

3.2.3.1 An engine mock-up of size (width x length x height) 1 m x 3 m x 3 m should be constructed of sheet steel with a nominal thickness of 5 mm. The mock-up should be fitted with two steel tubes diameter 0.3 m and 3 m length that simulate exhaust manifolds and a solid steel plate. At the top of the mock-up, a 3 m² tray should be arranged (see figures 1, 2 and 3).

3.2.3.2 A floor plate system 4 m x 6 m x 0.75 m high should surround the mock-up. Provision should be made for placement of the fuel trays, as described in table 1, and located as described in table 2.

3.2.4 *Instrumentation*

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

- .1 temperature of the generator casing;
- .2 temperature of the generator discharge stream measured at 0.5 m, 1.0 m and 2.0 m away from the discharge ports;
- .3 temperature at three vertical positions (e.g., 1 m, 2.5 m and 4.5 m);
- .4 enclosure pressure;
- .5 gas sampling and analysis, at mid-room height, for oxygen, carbon dioxide, carbon monoxide and other relevant products;
- .6 means of determining flame-out indicators;
- .7 fuel nozzle pressure in the case of spray fires;
- .8 fuel flow rate in the case of spray fires;
- .9 discharge nozzle pressure; and
- .10 means of determining generator discharge duration.

3.2.5 *Generators/nozzles*

3.2.5.1 For test purposes, generators/nozzles should be located as recommended by the manufacturer.

3.2.5.2 If more than one generator/nozzle is used, they should be symmetrically located.

3.2.6 *Enclosure temperature*

The ambient temperature of the test enclosure at the start of the test should be noted and serve as the basis for calculating the concentration that the agent would be expected to achieve at that temperature and with that agent weight applied in the test volume.

3.3 Test fires and programme

3.3.1 *Fire types*

The test programme, as described in table 3, should employ test fires as described in table 1 below.

Table 1
Parameters of test fires

Fire	Type	Fuel	Fire size, MW	Remarks
A	76 – 100 mm ID can	Heptane	0.0012 to 0.002	Tell tale
B	0.25 m ² tray	Heptane	0.35	(See Note 1)
C	2 m ² tray	Diesel/fuel oil	3	(See Note 1)
D	4 m ² tray	Diesel/fuel oil	6	
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 to table 1:

- 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 consist 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 m² in area. During the pre-burn period the crib should be placed centrally above the top of the tray a distance of 300 to 600 mm.
- 3 The polymeric sheet 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).

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

3.3.2 Test programme

3.3.2.1 The fire test programme should employ test fires singly or in combination, as outlined in table 3 below.

Table 3
Test programme

Test No.	Fire combinations (see table 1)
1	A: Tell tales, 8 corners. (see note)
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
3	C: 2 m ² diesel/fuel oil tray on deck plate located below solid steel obstruction plate F: Wood crib positioned as in figure 1 E: Low pressure, low flow horizontal spray – concealed – with impingement on inside of engine mock-up wall. H: Polymeric sheets positioned as in figure 1 Total fire load: 4.4 MW
4	D: 4 m ² diesel tray under engine mock-up Total fire load: 6 MW

Note to table 3:

- 1 Tell-tale fire cans should be located as follows:
 - .1 in upper corners of enclosure 150 mm below ceiling and 50 mm from each wall; and
 - .2 in corners on floors 50 mm from walls.

3.3.2.2 All applicable tests of table 3 should be conducted for every new fire-extinguishing media.

3.3.2.3 Only test 1 is required to evaluate new nozzles and related distribution system equipment (hardware) for systems employing fire-extinguishing media that have successfully completed the requirements of paragraph 3.3.2.2 above. Test 1 should be conducted to establish and verify the manufacturer's minimum nozzle design pressure.

3.4 Extinguishing system

3.4.1 *System installation*

The extinguishing system should be installed according to the manufacturer's design and installation instructions. The maximum vertical distance should be limited to 5 m.

3.4.2 *Agent*

3.4.2.1 Design application density

The agent design application density is the net mass of agent per unit volume (g/m^3) required by the system designer for the fire protection application.

3.4.2.2 Test density

The test density of agent to be used in the fire-extinguishing tests should be the design application density specified by the manufacturer, except for test 1, which should be conducted at not more than 77% of the manufacturer's recommended design application density.

3.4.2.3 Quantity of aerosol agent

The quantity of aerosol agent to be used should be determined as follows:

$$W = \frac{V \times q}{f} \text{ (g)},$$

where:

- W = agent mass (g);
- V = volume of test enclosure (m^3);
- q = design application density (g/m^3); and
- f = efficiency coefficient of the manufacturer's generator (%)

3.5 Procedure

3.5.1 *Fuel levels in trays*

The trays used in the test should be filled with at least 30 mm fuel on a water base. Freeboard should be 150 ± 10 mm.

3.5.2 *Fuel flow and pressure measurements*

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

3.5.3 *Ventilation*

3.5.3.1 Pre-burn period

During the pre-burn period the test enclosure should be well ventilated. The oxygen concentration, as measured at mid-room height, should not be less than 20% volume at the time of system discharge.

3.5.3.2 End of pre-burn period

Doors, ceiling hatches and other ventilation openings should be closed at the end of the pre-burn period.

3.5.4 *Duration of test*

3.5.4.1 Pre-burn time

Fires should 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 crib – 3 separate tests, one of 2 min, one of 4 min and one of 6 min; and
- .4 polymeric sheets – 210 s.

3.5.4.2 Discharge time

Aerosol agents should be discharged at a rate sufficient to achieve 100% of the minimum design density in 120 s or less.

3.5.4.3 Hold time

After the end of agent discharge the test enclosure should be kept closed for 15 min.

3.5.5 *Measurements and observations*

3.5.5.1 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; and
- .4 initial weight of wood crib.

3.5.5.2 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 time;
- .9 time at end of hold time;
- .10 at the start of test initiate continuous monitoring as per paragraph 3.2.4 above; and
- .11 for condensed aerosol generators:
 - .1 temperature of the casing during the fire test and hold time period; and
 - .2 temperature profile of the generator discharge stream versus distance away from the discharge ports.

3.5.6 ***Tolerances***

Unless otherwise stated, the following tolerances should apply:

- .1 length $\pm 2\%$ of value;
- .2 volume $\pm 5\%$ of value;
- .3 pressure $\pm 3\%$ of value;
- .4 temperature $\pm 5\%$ of value; and
- .5 concentration $\pm 5\%$ of value.

These tolerances are in accordance with standard ISO 6182-1:2004.

4 CLASSIFICATION CRITERIA

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

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

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

4.4 The wood crib weight loss should be no more than 30% during the 2 min pre-burn test, 50% during the 4 min pre-burn test and 60% during the 6 min pre-burn test.

4.5 A re-ignition test should be conducted after the successful extinguishments of the tell-tale fires in test 1 (Fire A) within 30 s after completion of discharge. The test should involve the attempted ignition of two of the tell-tale fire containers. One container should 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 should be energized for at least 10 s at each container. The test should 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.

4.6 For the polymeric sheets, the laboratory extinguishing factor for each fuel is that which achieves satisfactory extinguishment of the fire over three successive tests (no flaming 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.

5 TEST REPORT

The test report should include the following information:

- .1 name and address of the test laboratory;
- .2 date and identification number of the test report;
- .3 name and address of client;
- .4 purpose of the test;
- .5 method of sampling system components;
- .6 name and address of manufacturer or supplier of the product;
- .7 name or other identification marks of the product;

- .8 description of the tested product:
 - .1 drawings;
 - .2 descriptions;
 - .3 assembly instructions;
 - .4 specification of included materials; and
 - .5 detailed drawing of test set-up;
- .9 date of supply of the product;
- .10 date of test;
- .11 test method;
- .12 drawing of each test configuration;
- .13 identification of the test equipment and used instruments;
- .14 conclusions;
- .15 deviations from the test method, if any;
- .16 test results including measurements and observations during and after the test; and
- .17 date and signature.

APPENDIX 2

TEST METHOD FOR DETERMINATION OF AEROSOL GENERATOR EFFICIENCY COEFFICIENT

1 SCOPE

1.1 This test method is intended for measuring the mass of aerosol forming composition that is actually discharged by a fixed aerosol generator.

1.2 The test method is applicable to condensed aerosols.

1.3 The objective of the test programme is to establish the difference between the total mass of aerosol forming composition in the generator and the mass of composition that is discharged.

2 METHOD

2.1 The mass of aerosol forming composition in each type generator should be specified by the manufacturer.

2.2 The gross weight of each type generator should be determined by weighing on a laboratory scale.

2.3 An average of five generators should be discharged in an appropriate facility. After the generators have cooled, the average net weight of the empty generators should be determined using the same laboratory scale used in paragraph 2.2 above.

3 CLASSIFICATION CRITERIA

3.1 The efficiency coefficient (%) should be determined by subtracting the average weight of the generator after discharge from the weight prior to discharge, and dividing by the manufacturer's stated mass of aerosol forming composition.
