

The background and development of the guidelines in IMO Resolution A.800(19)

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Personal introduction

- Graduated Fire Protection Engineer from University of Lund in 1989.
- Employment as a fire protection consultant 1989-1991.
- Employed at SP Fire Research since October 1991.
- **Joined my first IMO Fire-Protection Sub-Committee meeting, FP38 in 1993.**
- Participated in the technical committee that developed the first edition of NFPA 750, published in 1996.
- Participated in the CEN committee on water mist fire protection systems 1998-2010.



What is IMO Resolution A.800(19)?

Title: REVISED GUIDELINES FOR APPROVAL OF SPRINKLER SYSTEMS EQUIVALENT TO THAT REFERRED TO IN SOLAS REGULATION II-2/12

The document was published by the International Maritime Organization (IMO) in 1995 and contains:

- Installation guidelines.
- Appendix 1: Component manufacturing standards.
- Appendix 2: Fire test procedures.

IMO is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships.



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**INTERNATIONAL
MARITIME
ORGANIZATION**

Starting point: The “Scandinavian Star” fire, 7 April, 1990



Arson fire. 158 fire deaths.
Revealed that current fire safety
requirements were outdated.



Aftermath: New requirements by the International Maritime Organization (IMO)

In December 1992, IMO adopted a comprehensive set of fire safety amendments, applicable to both new and existing passenger ships. The amendments required:

- The installation automatic sprinkler and smoke detection systems in accommodation and service spaces, stairways enclosures and corridors.
- The upgrading of fire safety bulkheads to non-combustible materials.
- Improved methods for assisting escaping persons, such as use of low location lighting.



Aftermath: New requirements by the International Maritime Organization (IMO)

The amendments applies to ships in international traffic, carrying more than 36 passengers. Ships were required to fulfil the requirements according to the following time schedule:

- New ships constructed after October 1, 1994.
- Ships constructed prior to SOLAS 1974 by 1997.
- Ships constructed in accordance with SOLAS 1974 by the year 2005 or within 15 years of construction, whichever came later.

FP36 (1991)

The Sub-Committee on Fire Protection was instructed to develop guidelines for the approval of “equivalent sprinkler systems” on passenger ships.

The installation of automatic sprinkler systems is described in SOLAS regulation II-2/12. The regulation had not been updated since 1974 and lacked the subsequent advances that had been made in sprinkler technology. This had resulted in a demand for the recognition of “equivalent sprinkler systems”.



FP37 (1992)

The United States submitted two documents to the meeting:

- Document FP37/8/4 that contained a draft revision to regulation II-2/12, reflecting the current state of proven automatic fire sprinkler system technology, including for examples pipe sizing by hydraulic calculation techniques, the use of fast-response sprinkler technology, appropriate water application rates, sprinkler spacing and operating pressure, the size of sprinkler sections, etc.
- Document FP37/8/5 that contained a proposal of the use of more economical automatic sprinkler systems, that incorporated the new technology of fast-response sprinklers and non-metallic piping material.



FP37 (1992)

Sweden submitted a document, FP37/8/1 that discussed “equivalent sprinkler systems”. The document contained two annexes:

- Annex 1 that listed draft basic installation requirements.
- Annex 2 that contained draft fire test procedures.

The draft fire test procedures covered fire scenarios in passenger cabins and public spaces, including a malfunction of a cabin sprinkler where the sprinklers in the attached corridor were required to prevent fire spreading from the cabin of origin.

FP37 (1992)

The document submitted by Sweden had been developed within a small working group that consisted of representatives from:

- The Swedish Maritime Administration.
- The Swedish Shipowners Association.
- Det Norske Veritas.
- The Swedish Rescue Services Board.
- SP Technical Research Institute of Sweden.
- One manufacturer, i.e., Marioff OY from Finland.

The Working Group at FP37 was instructed, with highest priority, to develop a draft Assembly resolution on “equivalent sprinkler systems”, based on these documents.



The adoption of IMO Resolution A.755(18)

During its 18th Assembly meeting in November 1993 the submittal from FP37 was considered and Resolution A.755(18), containing guidelines for the approval of sprinkler systems equivalent to that referred to in SOLAS Regulation II-2/12, was adopted.

The guidelines set forth 22 principal requirements for “equivalent sprinkler systems”, including that:

- Sprinklers should have fast-response characteristics.
- The area of operation should be 280 m².
- The system should be sized using a hydraulic calculation technique.
- Two sources of power should be available.
- The system must be capable of operation using sea water.

The adoption of IMO Resolution A.755(18)

Relative to the performance of the systems it was required that:

“The system should be capable of fire control and fire suppression under a wide variety of fire loading, fuel arrangement, room geometry and ventilation conditions.”

In addition, it was required that:

“The system and its components should be designed and installed in accordance with international standards acceptable to the Organization, and manufactured and tested to the satisfaction of the Administration.”

However, at this point of time, no such international installation or testing standards existed.



FP38 (1993)

Sweden submitted a document, FP38/3/3 with a revised proposal for fire test procedures for “equivalent sprinkler systems”:

- 12 m² cabin with Pullman bunk beds, connected to a 1 m wide and 12 m long corridor.
- A number of fire scenarios inside the cabin were proposed, with and without an open cabin doorway, different positions of the point of ignition, an “arson” fire, etc.
- One scenario simulated the malfunction of the sprinkler inside the cabin.
- For the corridor fire tests, the fire source consisted of a pile of small pieces of mattress material, positioned between two sprinklers.
- For the public space fire tests, a fire source that consisted of two sofas made of polyether mattresses arranged in a steel frame support was suggested.

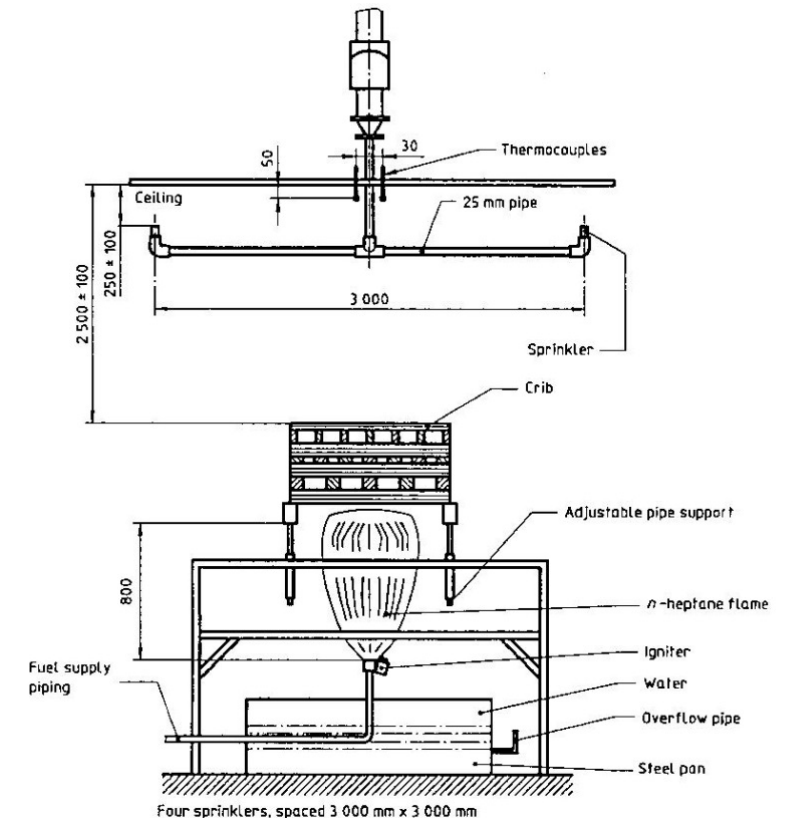
FP38 (1993)

- The acceptance criteria for the cabin and corridor tests were, at least partly, based on reference tests with standard sprinklers.
- The proposal lacked fire test procedures and fire test sources relevant for shopping or storage areas on board ships.

Additionally, the United States submitted a short document, FP38/3/4, where they suggested that the test standard used for residential sprinklers appears to be suitable for testing systems for use in cabins on board ships.

FP38 (1993)

- During the process of the development of the fire test procedures, a standard fire scenario in ISO/DIS 6182-1 was tested at SP in Sweden. However, it was judged that the performance was too scenario specific.
- As no final proposal was developed, it was decided at the Sub-Committee meeting to form a correspondence group to further develop appropriate fire test procedures for the equivalent sprinkler systems.



The work of the correspondence group (1994)

- Parts of the correspondence group met once, at the US Coast Guard headquarters in Washington D.C. in February 8, 1994.
- At that meeting, additional test data using standard sprinklers were presented to the group. The tests were conducted with the fire source suggested for public spaces, i.e. two sofas placed back-to-back. For some of the tests, however, the test set-up was further expanded to include a total of four sofas placed together.
- A total of nine tests were conducted at either 2.5 m or 5 m ceiling height and the number of sprinklers that activated, the fire damage and ceiling gas temperatures were recorded.



The work of the correspondence group (1994)

The meeting resulted in a number of proposed changes to the fire test procedures:

- The classification system of different occupancies provided by SOLAS regulations should be used - and there should be a clear correlation with the fire test hazard classification.
- A larger sized cabin was included in the fire test procedures, i.e. the “Luxury cabin test”. The suggested maximum size of the cabin was 24 m² with a square test compartment and two doorway openings.
- The suggested fire test source was the residential fuel package used by Underwriters Laboratories, Inc. or FMRC, Factory Mutual Research Corporation.



The work of the correspondence group (1994)

- The width of the corridor was increased, from 1 m to 1.5 m.
- Consensus was reached that no sprinklers in the corridor should be allowed to activate during a cabin test.
- The group agreed to add one or more tests simulating a corner public space fire scenario.
- The group discussed the advantage of a component malfunction test with a lower acceptance criterion, similar to the approach with the disabled cabin nozzle test.
- For the public space fire tests, several group members expressed their concern that the fire load was inadequate.

Technical report by the Factory Mutual Research Corporation (FMRC)

- Shortly after the meeting, FMRC distributed a preliminary technical report with comments to the draft fire test procedures in document FP38/3/3, although most of the content of the report had been discussed at the meeting.
- The preliminary technical report by FMRC also discussed shopping and storage areas.
- Based on a program sponsored by the National Fire Sprinkler Association (NFSA) and conducted by FMRC in 1989, an Ordinary Hazard fuel package had been developed. This scenario was suggested to be used.



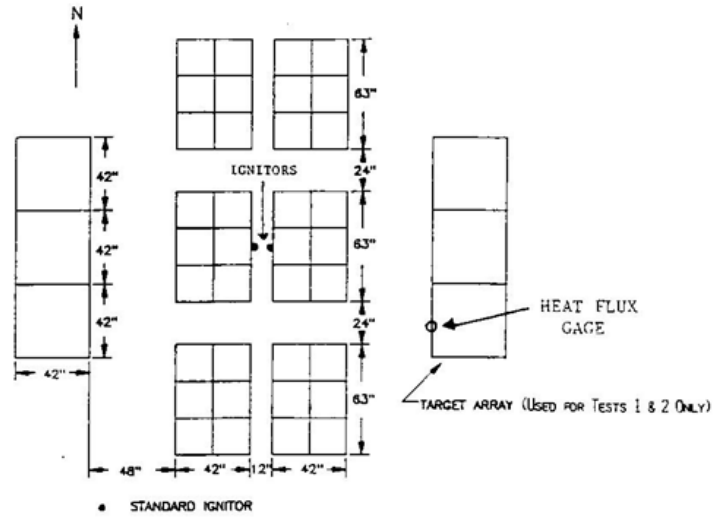


Figure 1a. Plan View of Fuel Arrangement.

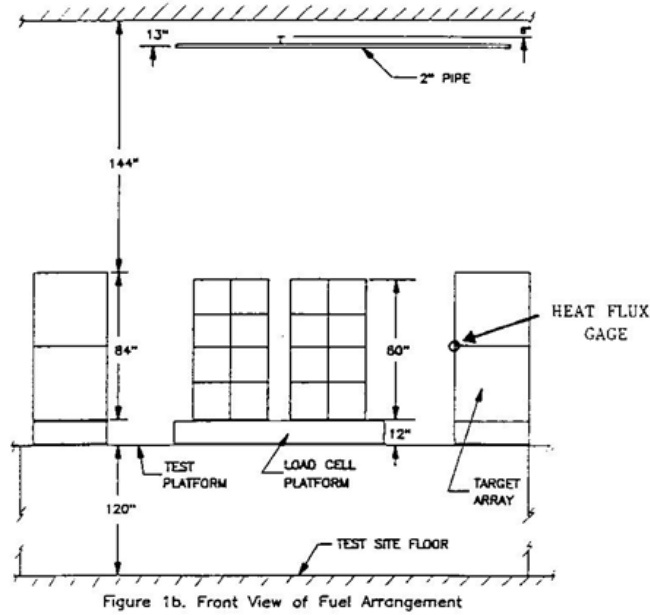


Figure 1b. Front View of Fuel Arrangement

FP39 (1994)

Document FP39/3/6 contained the report from the Correspondence Group and was submitted to the meeting.

- The document summarised the conclusions by the group, however, it did not contain any detailed fire test procedures.
- Such a document was brought to the informal pre-meeting that was held on the Sunday afternoon prior to the start of the IMO meeting week.
- The document contained all changes proposed by the Correspondence Group, including the proposed fuel package for shopping and storage areas.
- Test results were presented proving that the open public space fire test source could activate six sprinklers. The discussion on the adequacy of this particular fire source could therefore be put aside.
- Component test (nozzles only) procedures were suggested, based on UL 199.
- A draft document was submitted to the sixty-fourth session of the Maritime Safety Committee (MSC 64) for consideration and approval.

Concerns about the availability of polyether mattresses

- During the intervening months between FP39 and MSC 64, various tests were conducted using the draft fire test procedures.
- An inaccuracy in the description of the material specified for the polyether mattresses used for the cabin and corridor and public space fire tests was revealed.
- Tests conducted at VTT in Finland indicated that it was difficult to find “non-fire retardant” mattresses that fulfilled the Cone calorimeter values given in the fire test procedures.
- It was therefore suggested that the specification of the polyether mattresses should be changed and the Finnish delegation submitted a proposal to MSC 64 about this.



MSC 64 (1994)

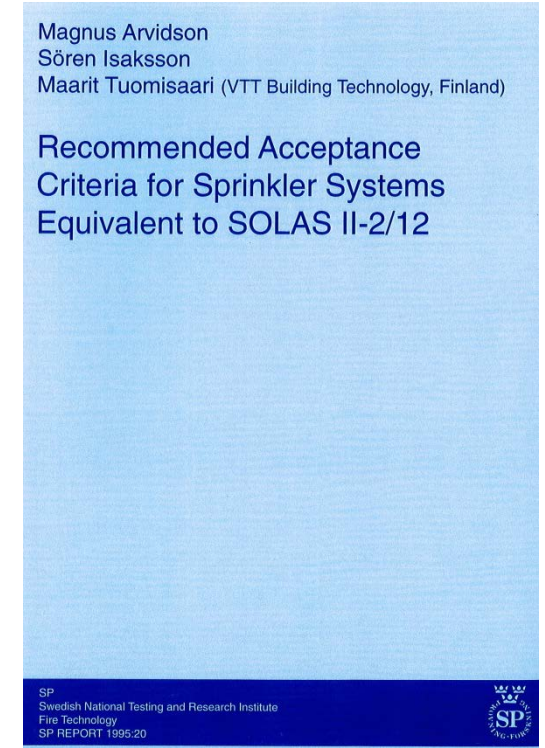
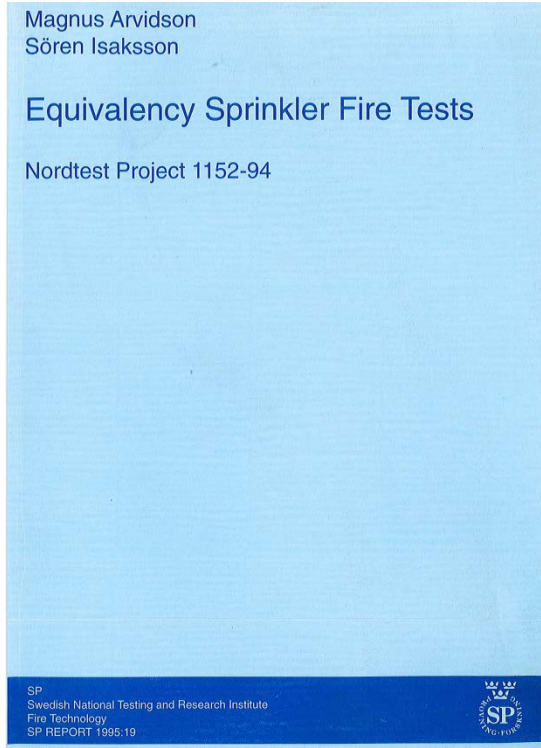
- During the meeting, the decision was made to revise the specifications of the polyether mattresses to increase the availability of suitable material.
- The acceptance criteria that previously had been established was no longer valid.
- The intention was therefore to provide guidelines for fire test laboratories how to conduct reference sprinkler tests. The sprinkler and the installation were specified as follows:

“ISO 6182-1 type spray pendent with:

- *K-factor: 80 (metric), 15 mm sprinkler*
- *Time Response Index $RTI \leq 120$ (metric)*
- *Water density ≥ 5 l/m²/min*
- *Spacing ≤ 4 m*
- *Installation according to SOLAS II-2/12”*

Reference sprinkler tests (1995)

- SP and VTT agreed to collaborate on establishing performance criteria with standard sprinklers.
- Beginning of 1995, they independently carried out reference sprinkler tests with two types of standard response spray sprinklers that fulfilled the requirements given above.
- A limited number of tests were conducted with sprinklers having fast-response characteristics.
- On the basis of the results, a collaborative project was undertaken in defining recommended acceptance criteria for the accommodation and public space fire tests.







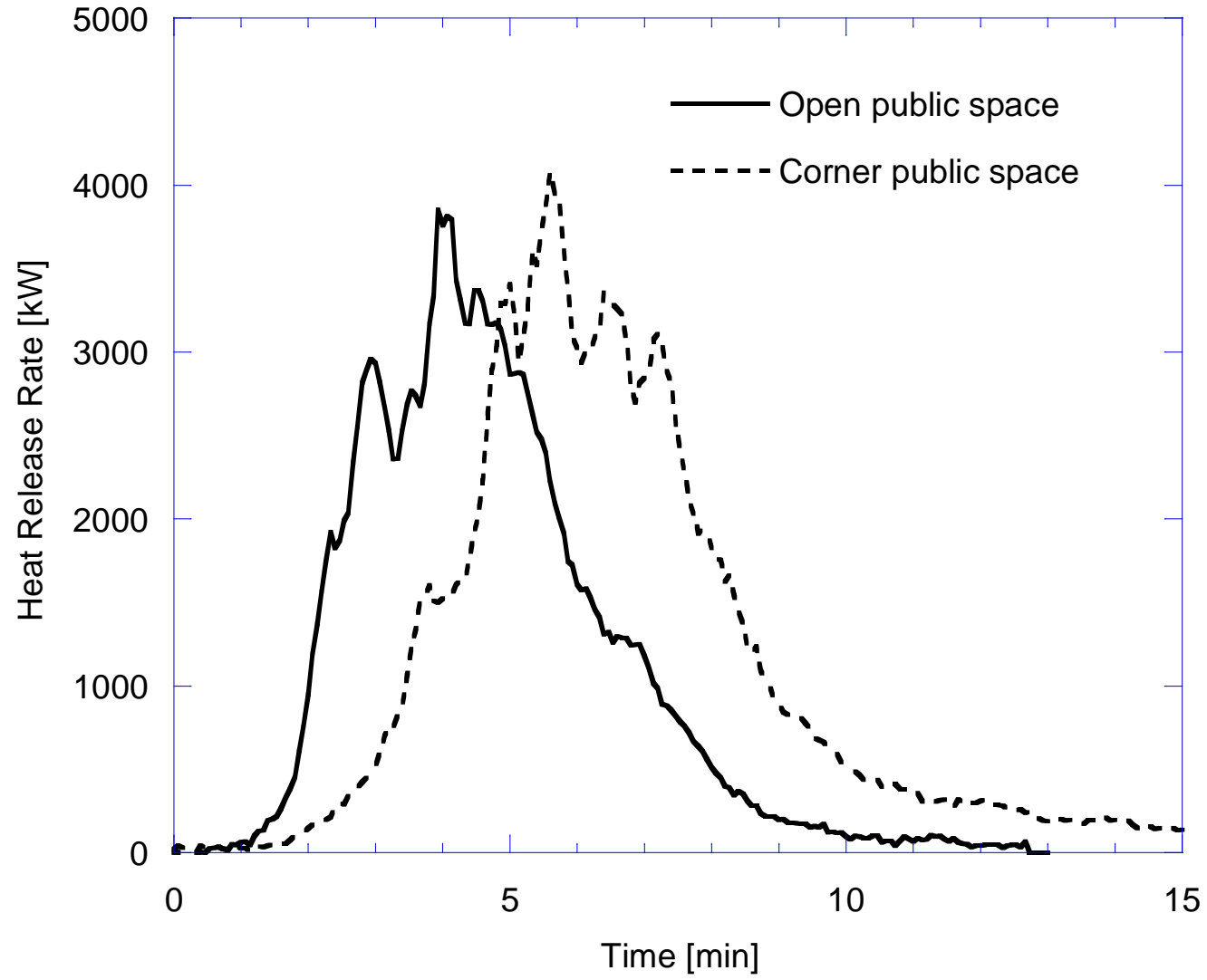
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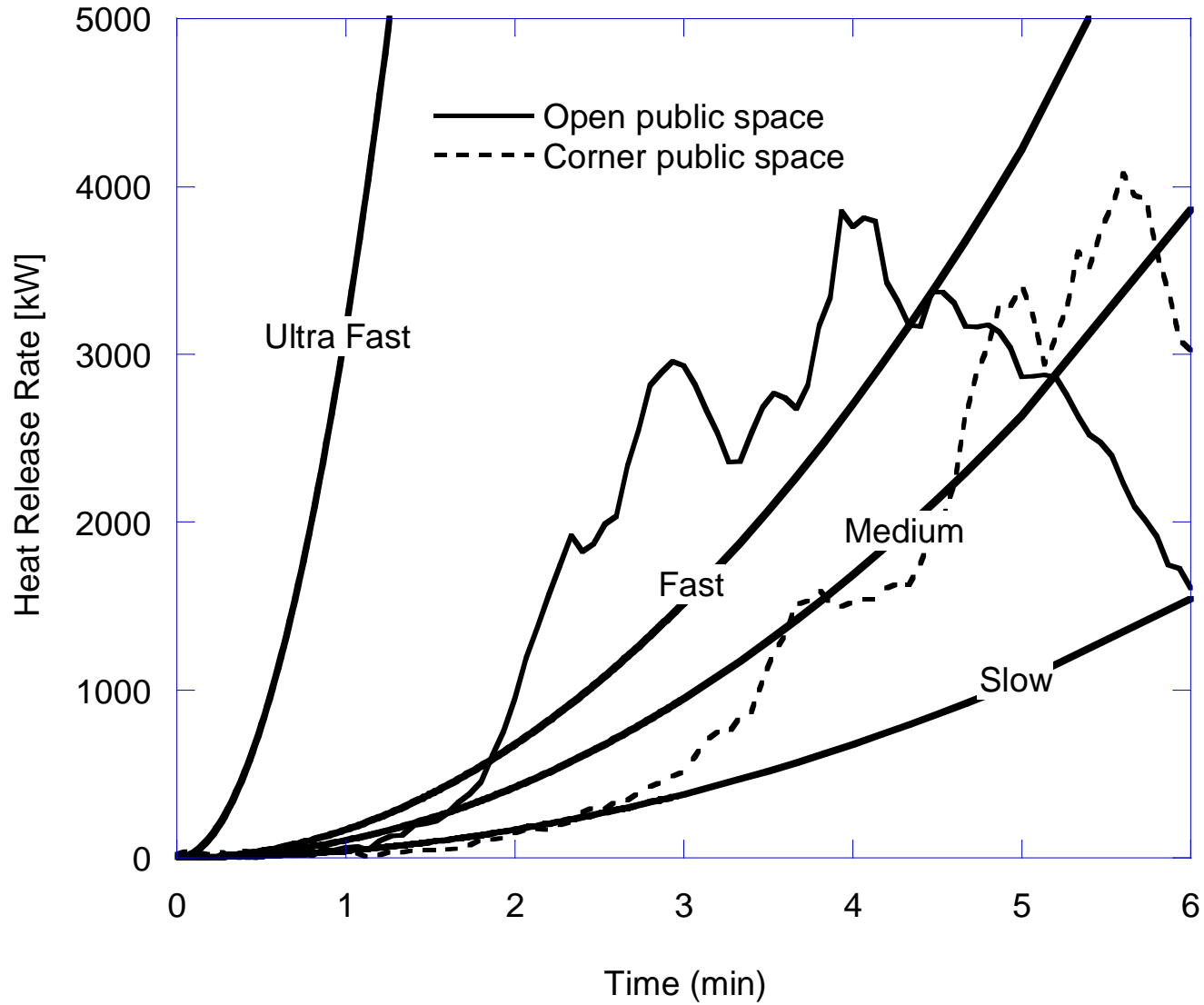


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Heat Release Rate



Heat Release Rate



FP40 (1995)

Several documents related to the test procedures for equivalent sprinkler systems were submitted to the meeting:

- Finland and Sweden submitted a joint document, FP40/5/8 , that summarised the outcome of the reference sprinkler tests and provided suggested acceptance criteria.
- The United Kingdom submitted a document, FP40/5/6, with similar information, based on direct contact with VTT.
- Finland submitted a document, FP40/5/4 which discussed the correlation between the occupancy classification and the fire tests.
- The United States submitted a document, FP40/5/2, where they argued that fire tests should be amended to ensure that appropriate levels of life safety and vessels protection are provided by the equivalent systems. However, the document did not contain any specific suggested amendments.

The adoption of IMO Resolution A.800(19)

The guidelines for approval of equivalent sprinkler systems was adopted at the 19th IMO Assembly that was held in November 1995 as Resolution A.800(19) which marked the end of the work that started in 1991.



In summary

- The “Scandinavian Star” fire occurred in 1990.
- The Sub-Committee on Fire Protection was instructed to develop guidelines for approved “equivalent sprinkler systems” in 1991.
- IMO adopted a comprehensive set of fire safety amendments, applicable to both new and existing passenger ships in 1992.
- IMO Resolution A.755(18) containing guidelines for approved “equivalent sprinkler systems” was adopted in 1992.
- With these requirements as the basis, the process of developing fire test procedures and a component manufacturing standard for nozzles started at FP38 in 1993.
- IMO Resolution A.800(19) was published in 1995.



In summary

The fire test procedures covers the wide variety of fire load, fuel arrangement, room geometry and ventilation conditions typically found on board passenger ships, by using the following different fire test scenarios:

- Cabin fire tests.
- Corridor fire tests.
- Luxury cabin fire tests.
- Open and corner public space fire tests.
- Shopping & Storage area fire tests.

The acceptance criteria are directly or indirectly based on the performance of standard sprinklers.

The component tests (nozzles only) were adopted from UL 199.



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