LASH FIRE

Legislative Assessment for Safety Hazards of Fire
and Innovations in Ro-Ro Ship Environment

The development of a sprinkler system concept for vehicle carriers

Magnus Arvidson, RISE

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LASH FIRE

LASH FIRE Coordinator RISE

Legislative Assessment for Safety Hazards of Fire and Innovations in Ro-ro ship Environment

LASH FIRE is an international research project aiming to significantly reduce the risk of fires on board ro-ro ships.

The project is running from September 2019 to August 2023.

For more information: www.lashfire.eu

Strategic objective

"To provide a **recognized technical basis** for the revision of international **IMO regulations**, which greatly **enhances fire prevention** and **ensures independent management of fires** on ro-ro ships in current and **future** fire safety challenges."

The consortium

LASH FIRE Coordinator RI.SE

CIMNE

INTERFERRY Representing the Ferry Industry World-Wide

FLOW SHIP DESIGN

University of Cyprus

UNIFIRE

FIFI4MARINE

SEA Europe Shipyards' & Maritime Equipment Association

VTT

Fike

DFDS

RS2N

Stena

RI.SE

NTNU Knowledge for a better world

AP SENSING advanced photonic

Marioff United Technologies

magellan European Affairs Consultancy

CMT Center of Maritime Technologies gGmbH

BUREAU VERITAS

UNIVERSITÉ DE LORRAINE

SICK Sensor Intelligence.

NTNU Social Research

20 challenges

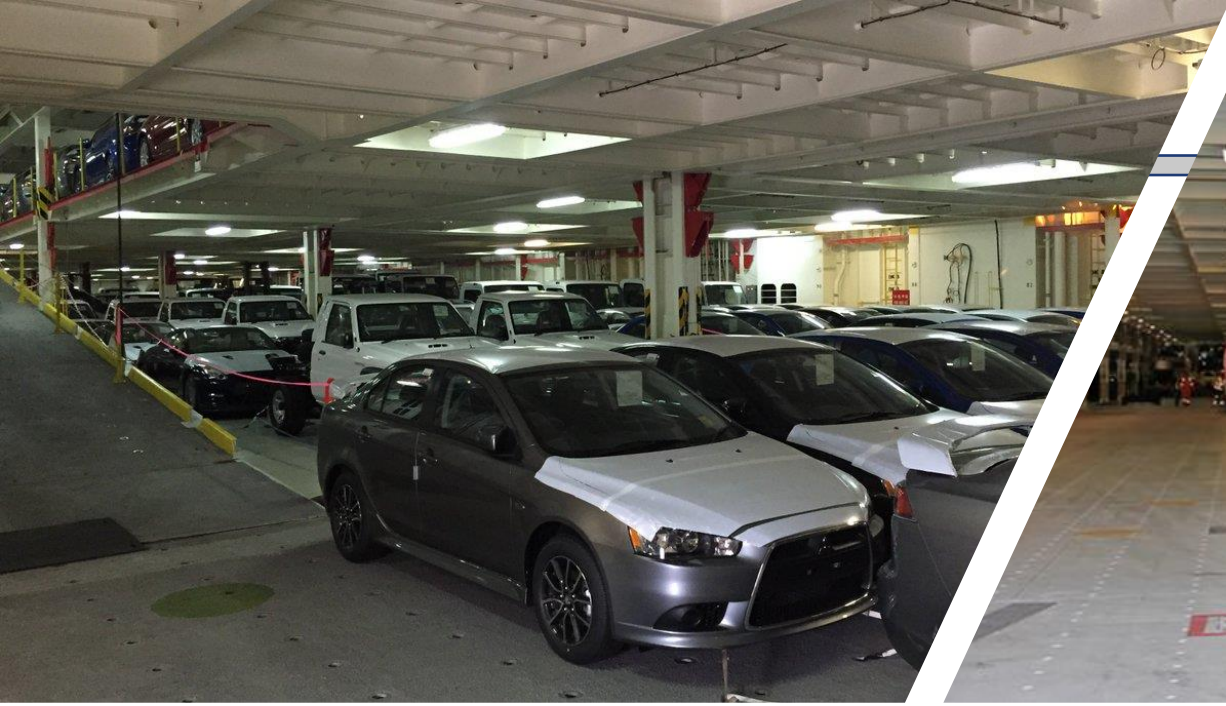
LASH FIRE Coordinator RISE

WP06	**Effective Manual Operations**	**Validation**
6-A	Manual screening of cargo fire hazards and effective fire patrols	Onboard/Terminal
6-B	Quick manual fire confirmation and localization	Onboard
6-C	Efficient first response	Onboard
6-D	Effective and efficient manual firefighting	Onboard/Field
WP07	**Inherently Safe Design**	**Validation**
7-A	Improved fire detection system interface design	Onboard/Virtual
7-B	Efficient extinguishing system activation and inherently safe design	Onboard
7-C	Firefighting resource management centre	Onboard/Virtual
WP08	**Ignition Prevention**	**Validation**
8-A	Automatic screening and management of cargo fire hazards	Onboard/Shore
8-B	Guidelines and solutions for safe electrical connections	Onboard
8-C	Fire requirements for new ro-ro space materials	Lab
WP09	**Detection**	**Validation**
9-A	Detection on weather deck	Onboard
9-B	Detection in closed and open ro-ro spaces	Onboard
9-C	Technologies for visual fire confirmation and localization	Onboard
WP10	**Extinguishment**	**Validation**
10-A	Local application fire-extinguishing systems	Lab
10-B	Weather deck fixed fire-extinguishing systems	Onboard
10-C	Updated performance of alternative fixed fire-fighting systems	Lab
WP11	**Containment**	**Validation**
11-A	Division of ro-ro spaces	Lab/Onboard
11-B	Ensuring safe evacuation	Virtual/Shipyard
11-C	Safe design with ro-ro space openings	Virtual/Lab
11-D	Ro-ro space ventilation and smoke extraction	Lab/Onboard

Vehicle carriers

The generic vehicle carrier in LASH FIRE: MS Torrens.

- No passengers.
- Closed vehicle spaces.
- Transports regular cars but also trucks and other large vehicles.
- Often new vehicles.
- 12+ decks common.
- Liftable decks for flexibility.
- Typically protected by a total-flooding Carbon Dioxide system.



The problem

- Often a long delay time from fire start to the discharge of the Carbon Dioxide system.
- This results in severe fire damage.
- Examples of severe fires:
  - Courage (2015).
  - Honor (2017).
  - Höegh Xiamen (2020).
  - Felicity Ace (2022).

The task

- Develop and demonstrate efficient water-based fire protection system solutions for closed ro-ro spaces on vehicle carriers.

- Quick system activation and fast local fire suppression performance are fundamental criteria for the systems as well as low cost and weight.

- Complementary to the fixed-installed Carbon Dioxide system.

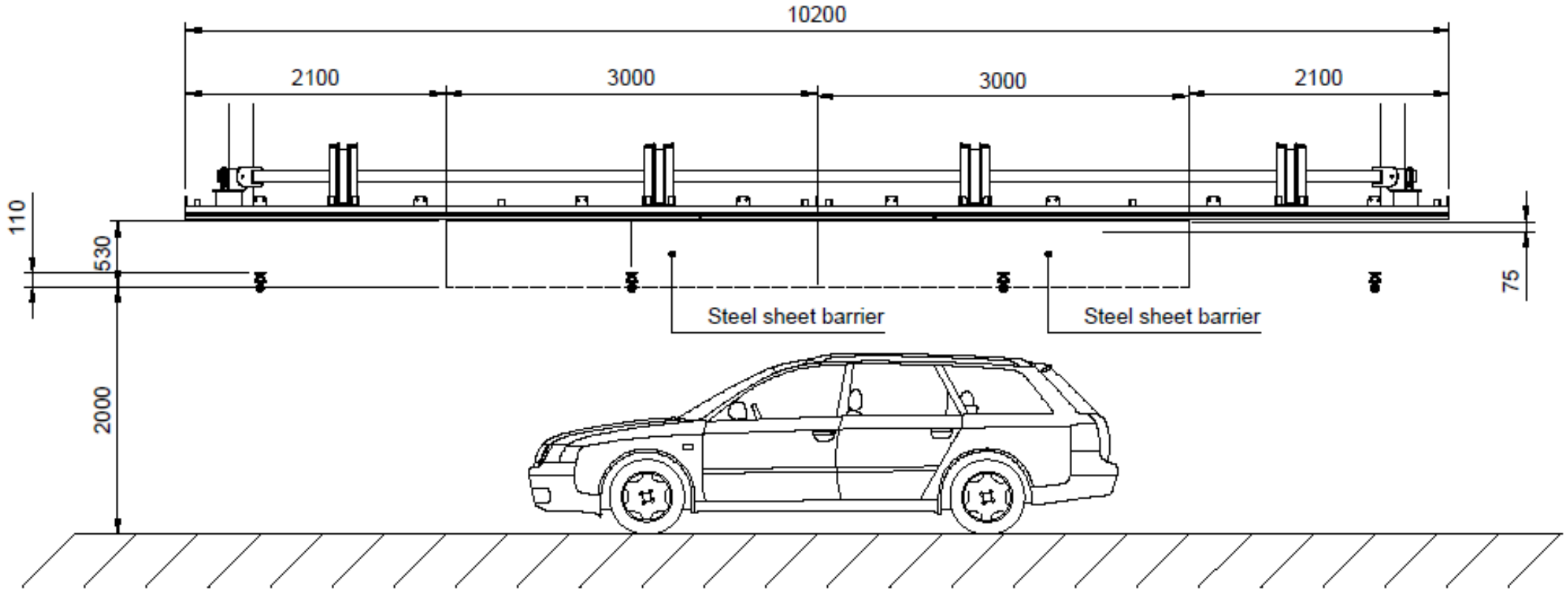
Large-scale validation tests

- Two sprinkler system solutions were tested:
  - A dry-pipe sprinkler system (per definition an automatic system).
  - An automatic deluge water spray.
- CAFS was pre-tested in other tests but was disregarded due to high installation and operation costs.
- (Water mist systems were out of the scope of the project).

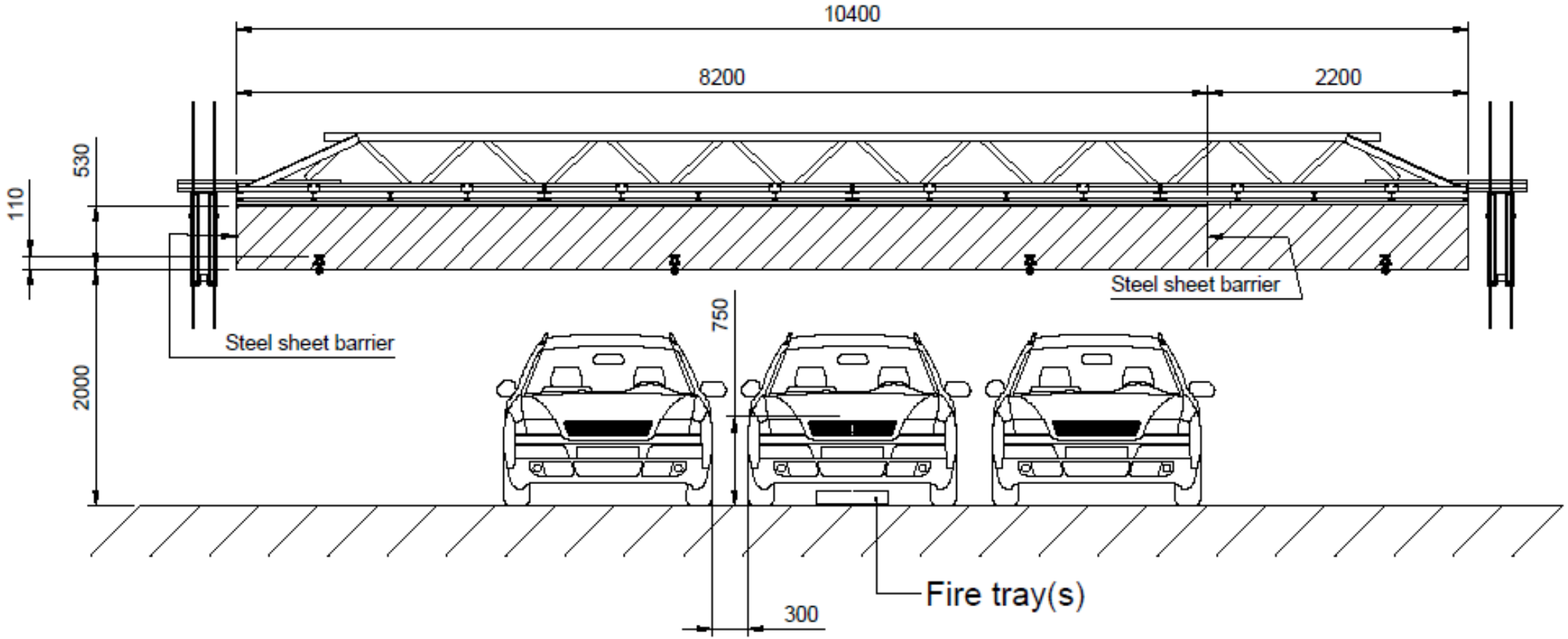
Large-scale validation tests

- A total of six validation tests were conducted:
  - Test 1: Dry-pipe sprinkler system (2,0 m clear height).
  - Test 2: Dry-pipe sprinkler system (2,0 m clear height).
  - Test 3: Automatic deluge water spray (2,0 m clear height).
  - Test 4: Automatic deluge water spray (2,0 m clear height).
  - Test 5: Dry-pipe sprinkler system (2,8 m clear height).
  - Test 6: Dry-pipe sprinkler system (4,6 m clear height).

Fire test set-up (Tests 1-4)

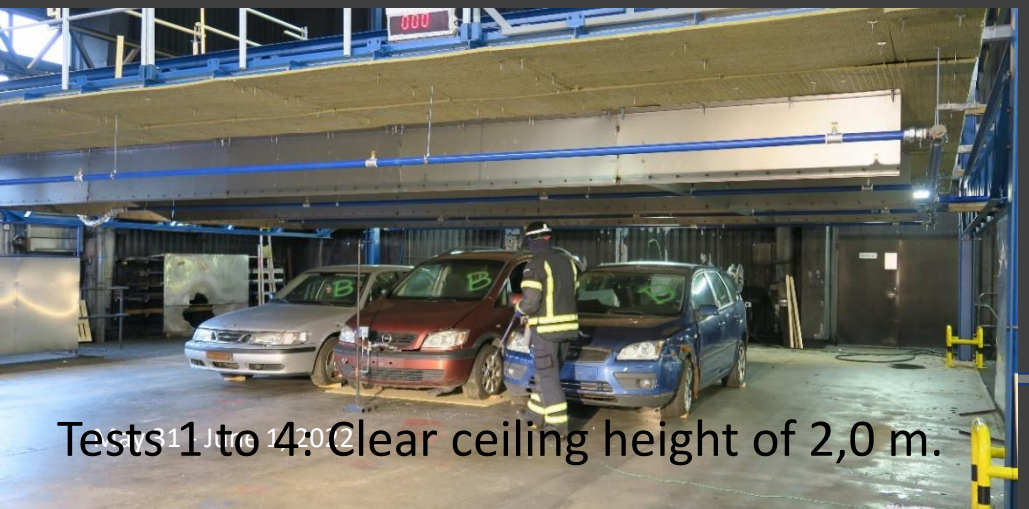


Fire test set-up (Tests 1-4)



Test 6: Clear ceiling height of 4,6 m.

Test 5: Clear ceiling height of 2,8 m.



Tests 1 to 4: Clear ceiling height of 2,0 m.

Fire test set-ups

Test 1

Dry-pipe system (upright sprinklers).
Fire ignition inside the middle car with a side window folded down.
Photo: 02:49 [min:s], a few seconds before water discharge.

Test 1
Photo: 15:10 [min:s].
The fire flared up as a window broke but the fire was controlled by the system.
Three sprinklers activated, discharging 10 mm/min.

Test 1

No fire spread to adjacent cars.
Several windows of the middle car broke, and the interior was severely burnt.

Test 6

Dry-pipe system, with standard response, high-temperature sprinklers.

A 45 s delay time was used to account for the water travel time.

Photo: 02:00 [min:s], a few seconds prior water was discharging from the sprinklers that had activated.

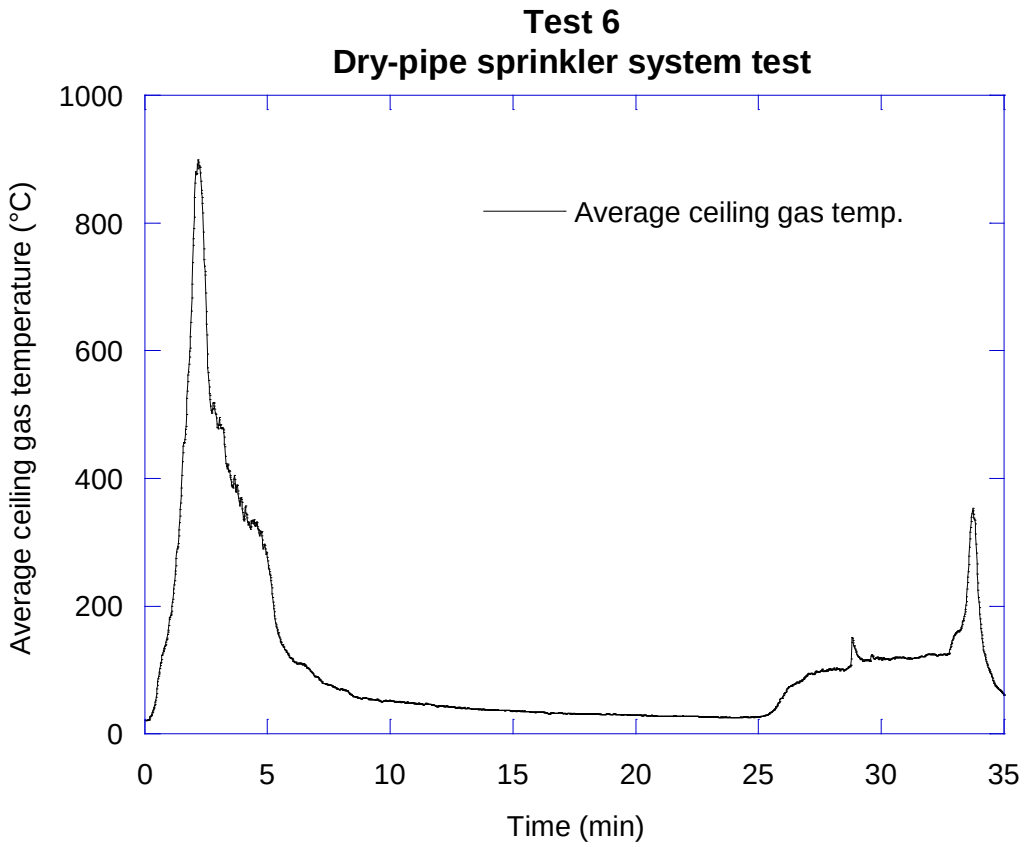
Test 6

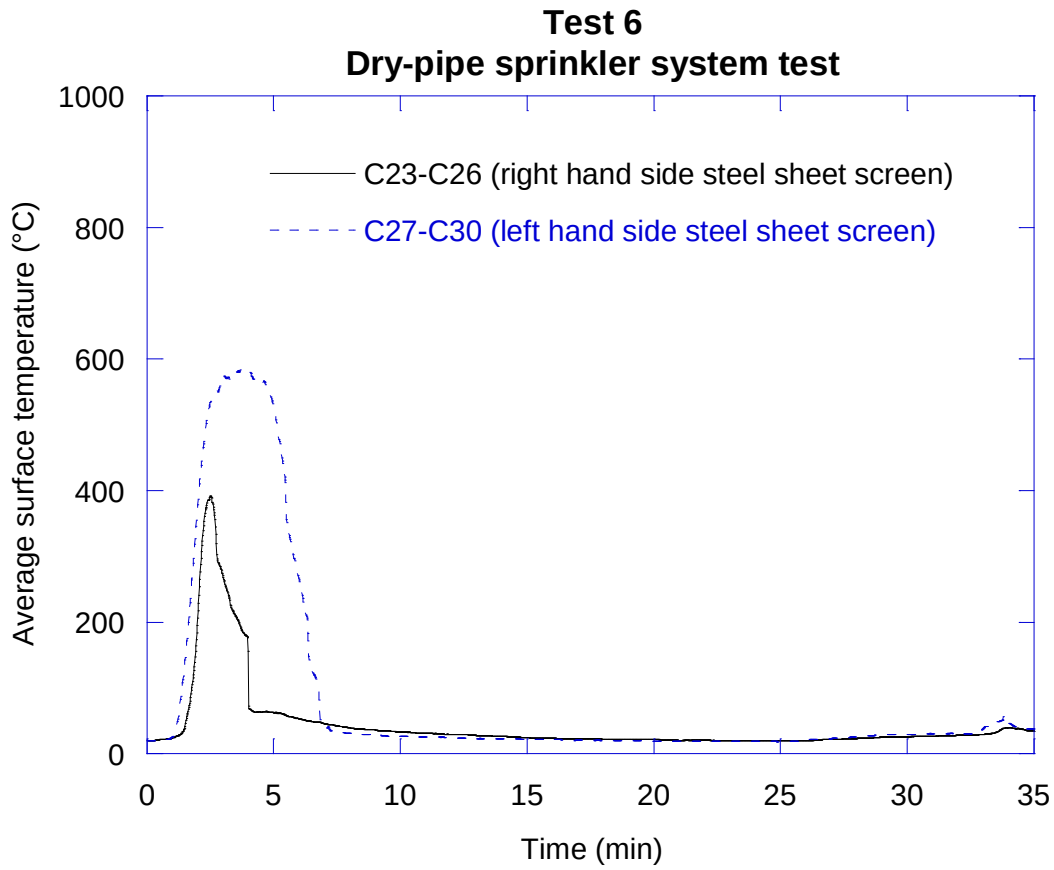
Seven sprinklers activated, discharging 17,5 mm/min.
The fire size was gradually reduced.
Ceiling gas temperatures were reduced within a few minutes.
The surface temperatures on the ‘target’ steel sheet screens effectively reduced.

Test 6

Fire damage to the interior and exterior.

Test 6: Test results





Conclusion

- A fire representative for vehicle carriers is controlled by the suggested system solutions.
- This will allow time for the operation of the fixed-installed Carbon Dioxide system and reduce overall fire damage.
- Automatic (as desired) activation is important.
- A concept for the installation of automatic sprinklers for ‘obstructed ceiling constructions’ was tested and proven to work.

The system design proposal

Type of system	Clear height	Nominal temperature rating (°C)	RTI rating	Minimum discharge density (mm/min)	Minimum operation area (m^2)
Wet-pipe	≤2.4 m	70	Fast- or standard-response	10	144
Dry- or pre-action		70	Fast- or standard-response		180
Deluge		-	-	7.5	2 or 4 deluge sections
Wet-pipe	>2.4 m - ≤4.0 m	70	Standard-response	15	144
Dry- or pre-action		140	Standard-response		180
Deluge		-	-	10	2 or 4 deluge sections
Wet-pipe	>4.0 m - ≤7.0 m	70	Standard-response	20	144
Dry- or pre-action		140	Standard-response		180
Deluge		-	-	15	2 or 4 deluge sections

Acknowledgements

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