Developing of a new test protocol for Quick Suppression Systems

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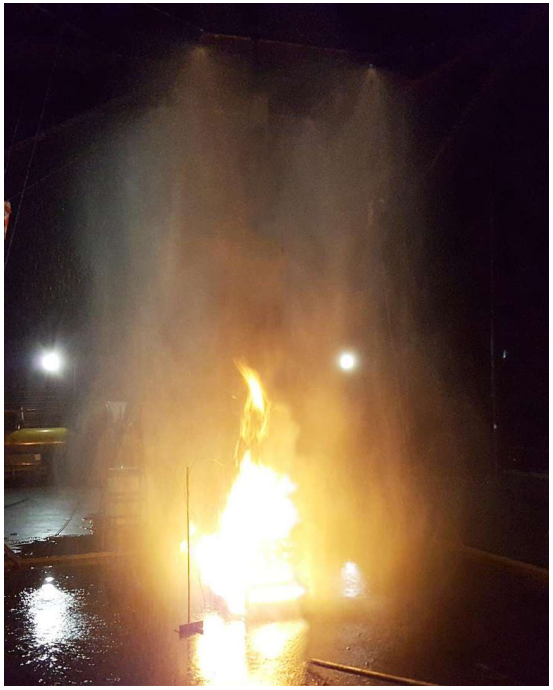
Overview of presentation

- Fire risks in industries handling dry and finely divided material
- Conventional fire protection methods
- The ‘Quick Suppression System’ concept
- New test protocol for Quick Suppression Systems – DFL TM170307-1261
- Description of test series 1-9 in DFL TM170307-1261 and comments from performed tests
- Risk Assessment
- Conclusion



Fire risks in industries handling dry and finely divided material

- The fire risk in these facilities can be extremely high

- The biggest fire risk is often related to a few specific machines or areas in the plant

For example:
- Shredders in recycling industry
- Planers, saws and sanders in wood industry
- Dryers (any industry)

A fire in these type of machines can quickly cause damages and result in a costly down time

If the fire is not stopped in time, it can rapidly be spread to other areas

Conventional methods often used in industries handling dry and finely divided material

Spark Detection Systems
Detection and extinguishing of ignition sources before the fire has started

Designed for protection inside the process. Does not cover the surrounding of a machine and are not designed and approved for extinguishing of fires

Sprinkler Systems:
Normally designed as an overall protection of a facility

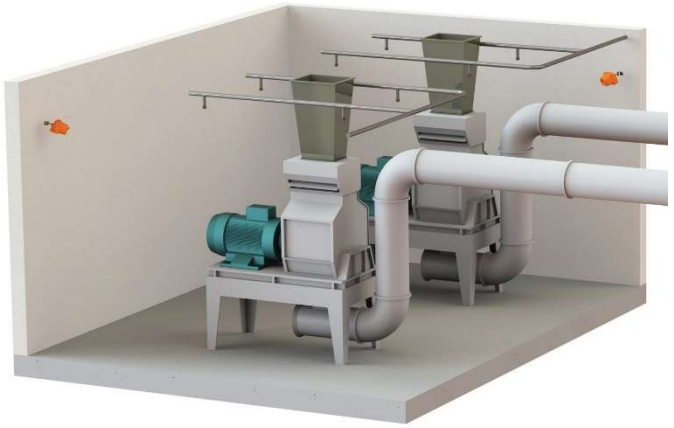
Not as suitable for local protection of critical machines due to slow response times and because of the large water volumes

The ‘Quick Suppression System’ Concept

To increase safety in critical machines and/or high risk areas a new fire protection concept was developed by Firefly

The concept is based on **flame detection** and **water mist** extinguishing and designed as a **complete system** with extremely quick response time

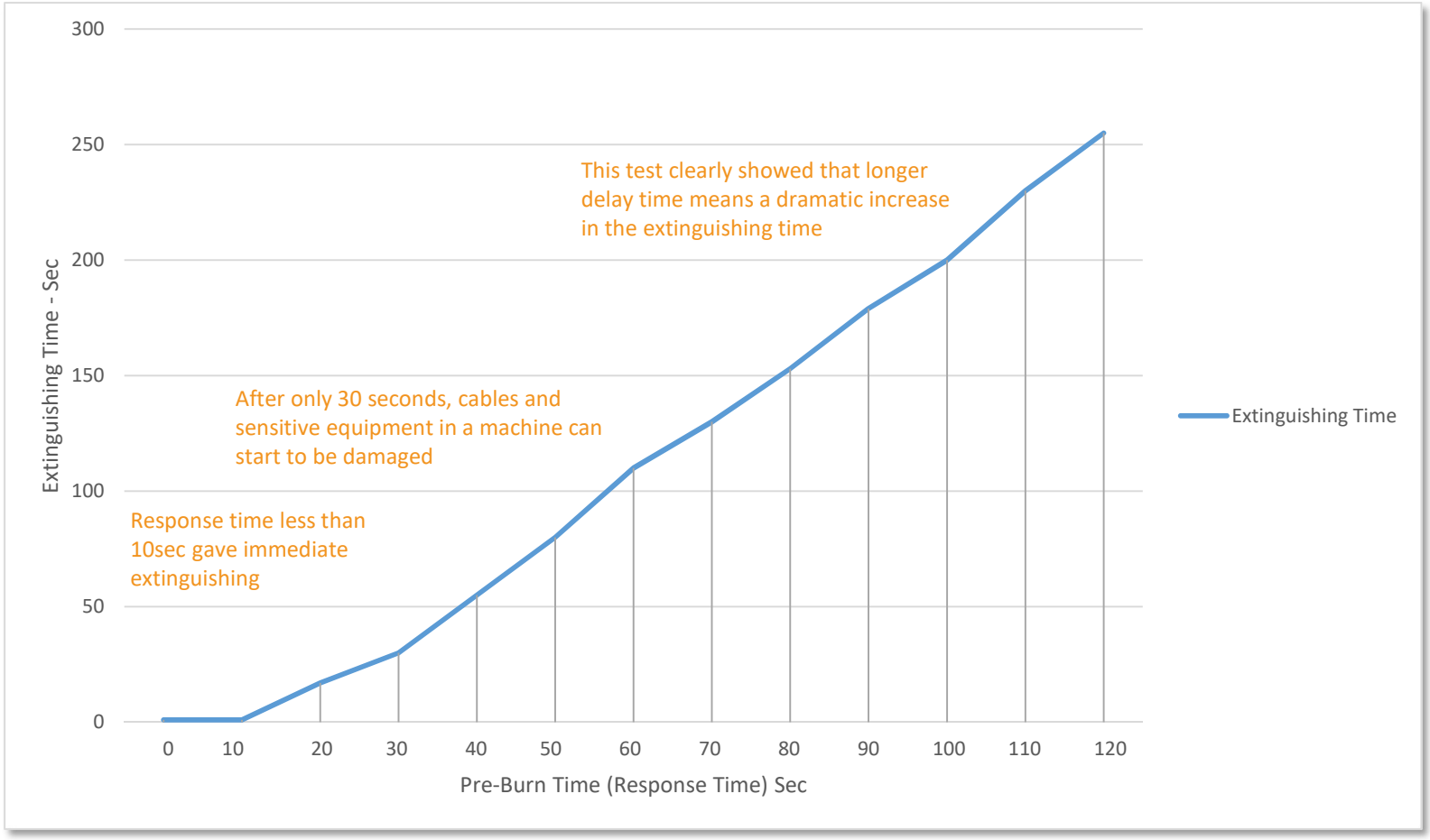
The purpose was to develop a system that acts quickly enough to avoid damages and production downtime, thus saving costs and increase safety of personnel



Video showing on site test of Quick Suppression System

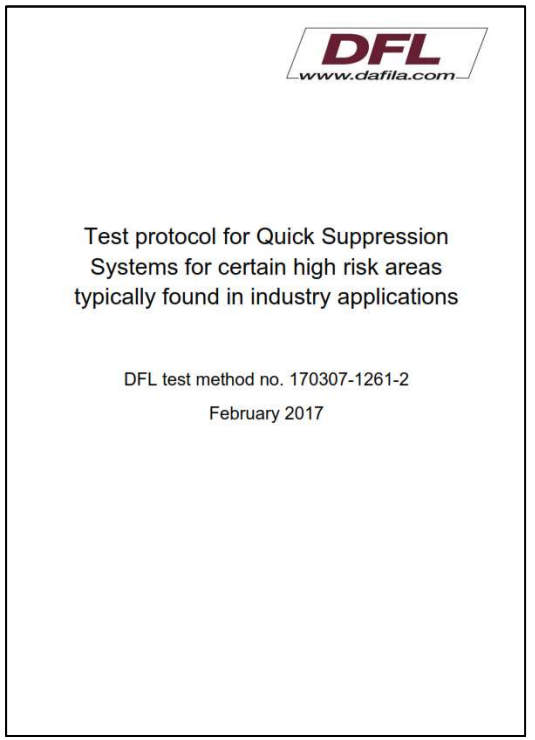
Quicker response time = Faster Extinguishing time

Tests were done to show the relation between the response time of a system vs. extinguishing time.
Fuel: Wood crib



New Test Protocol

- Until 2016 – there were no applicable test protocol for systems like ‘Quick Suppression Systems’
- Year 2016-2017 a new test protocol for Quick Suppression Systems – DFL TM170307-1261 was developed
- Continuous feedback from expert from the Insurance industry and risk management companies during the work
- The test method is done according to Water Mist standard CEN/TS 14972:2011, Appendix B
- The purpose was to make a “conservative” test method with strict requirement on system quickness and extinguishing times
- It also includes requirements on detection and control system, which is unique for this type of test protocols



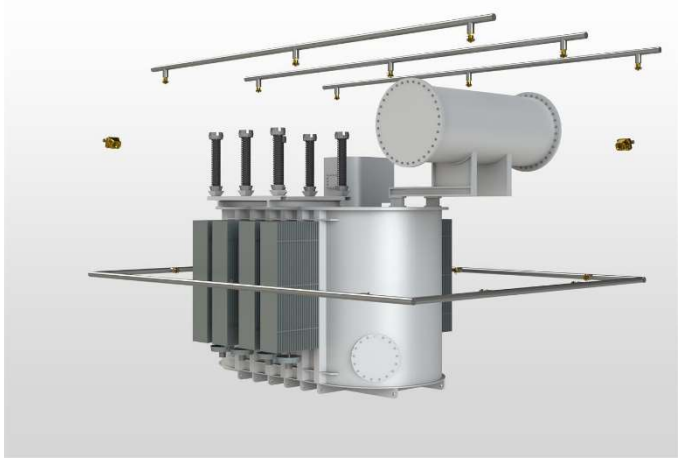
Quick Suppression System

Definition:

'A Quick Suppression System is a Fixed Automatic Discharge Fire Suppression System, including detection, control system and suppression, with strict demands on quick system response times and fast extinguishing performance'

The DFL 170307-1261 test method is an open test protocol and can be used by any provider of fire protection systems

The name 'Quick Suppression System' is a general term and not a registered trademark by any company



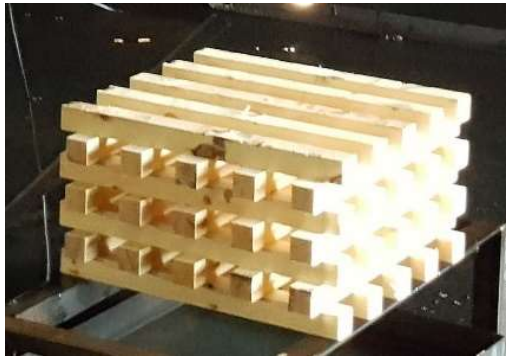
Test protocol - DFL TM170307-1261

- **Test Series 1** - Local protection of loading stations, such as shredder top parts
- **Test Series 2** – Local protection of volumes below machines, such as shredder bottom parts
- **Test Series 3** - Zoned deluge protection of conveyors
- **Test Series 4** - Local protection of mechanical machines
- **Test Series 5** - Local protection of surrounding risks found next to mechanical Machinery
- **Test Series 6** - Total flooding protection of mechanical machines located inside enclosures larger than 30 m3
- **Test Series 7** - Total flooding protection of mechanical machines located inside enclosures equal to or smaller than 30 m3
- **Test Series 8** - Comparison test between test method fuel package and real life fire risk
- **Test Series 9** – Verification of the response time of detection and control system

Fuel / Fire load – Class A Fires

Wood cribs

Wood cribs are demanding to extinguish for water mist due to the powerful draft created in the center of the wood crib ("Chimney effect")



The wood crib shall be made of "pinus silvestris" having a density of 0.4-0.65 kg/dm and containing 10%15% moisture by mass, according to European Standard EN 3-7:2004+A1:2007, annex I.2.1

This will ensure consistency, reliability and reproducibility of the fire tests

The wood cribs are ignited by heptane located in a metal tray under the wood crib

Fuel / Fire load – Class B Fire

<u>Diesel Pool Fire</u>

Class B fuel according to European Standard
EN 3 7:2004+A1:2007, annex I.2.1

Diesel-DO with flash point of 40,1^{o}C was chosen in this test protocol

The hazards protected may involve fuels with a similar or higher closed-cup flash point than used in the fire test

Common class B fuels occurring in industrial applications are:
- Hydraulic oil (flash point typically 150-315^{o}C)
- Lubrication oil (flash point typically > 200 ^{o}C)

Pre-Burn Time

The tests were done with a pre-burn time of **1 minute** for all fire tests

This is to make sure that the system is capable of extinguishing deep seated fires

In reality the extinguishing system is to be activated in just a few seconds with a Quick Suppression System, meaning that the **extinguishing time in a real application is normally much shorter!**

Maximum accepted time to extinguishing the fire

Maximum accepted time to extinguish the fire in the DFL 170307-1261 is
5 or 7 minutes depending on the test

Other Standards or Test protocols

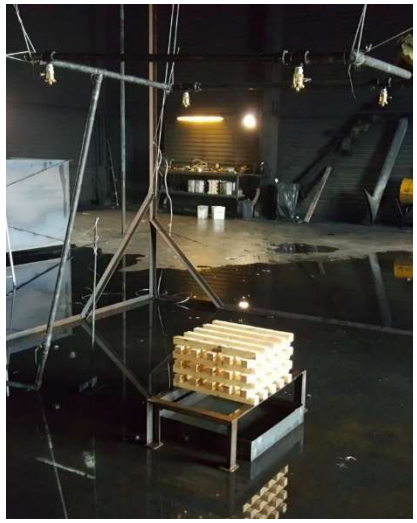
The criteria in most fire test protocols is “suppression and control”

All fire tests in the Quick Suppression Test protocol requires
FULL EXTINGUISHING

Test parameters

The Tested parameters sets the limit for the actual use in regards to:

- Nozzle type
- Minimum operating pressure
- Maximum nozzle spacing
- Minimum and maximum nozzle height
- Nozzle angles / orientation
- The nozzle location and positioning



General test conditions

Fire test laboratory shall be accredited to ISO/IEC 17025

The laboratory test hall must have a minimum volume of 5000 m^3 and a minimum height of 12,00 m. The test hall shall also be able to provide sufficient oxygen to the fire tests.

The laboratory shall minimum be able to measure temperature, water flow, water pressure, and heat release rates (HRR) with traceable and accredited calibrated measuring equipment.

Explanation of the test protocol and experience from executed tests

Following part of the presentation is a short explanation of the test protocol and our comments / experience from the executed tests

Test series 1

Application - Local protection of loading stations, shredder top parts etc

A mock-up was built in metal to simulate real applications, such as:

- Shredder top part
- Loading stations
- Etc

No specified nozzle location

Fuel

Wood crib 34A (0,5x3,4x0,55m)

Comment

Firefly decided to make one test series with nozzles above and one test series with nozzles at the side wall of the mock-up

Example of real applications

Mock-ups for Test series 1

Video – Fire test – Test series 1

Fire test (Wood Crib 3,4m) – 1 minute pre-burn time with heptane. Nozzle height 4,2m

Test series 2

Application – Local protection of volumes below machines, such as shredder bottom parts

A mock-up was built in metal to simulate real applications, such as:

- Shredder bottom part
- Etc

No specified nozzle location

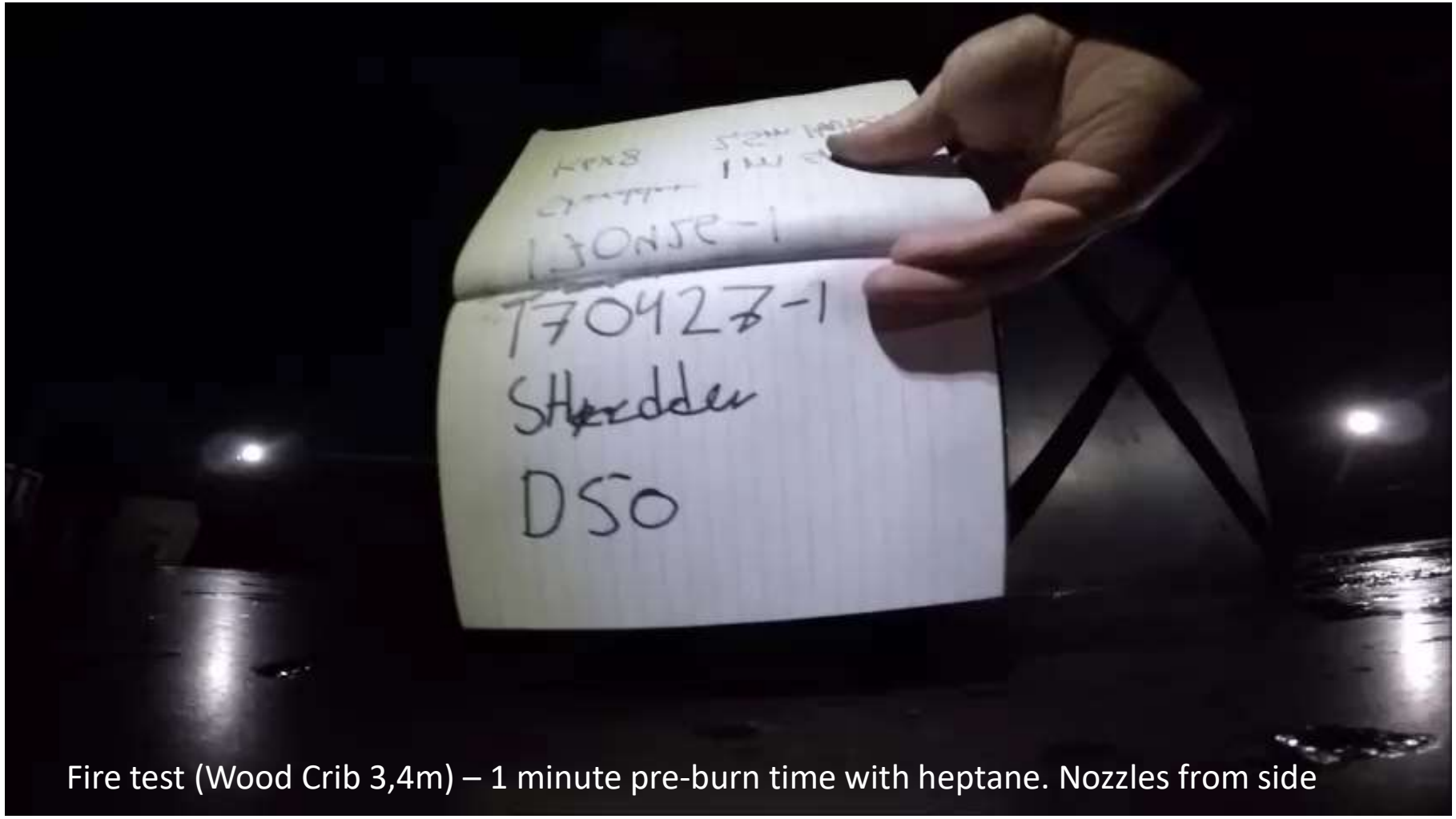
Fuel
Wood crib 34A (0,5x3,4x0,55m)

Comment

In the bottom part of a shredder it is only possible to locate nozzles from the side, so Firefly decided to make the test with nozzles from the side only

The volume of the box is 12m³ and the opening in the bottom part is 4 m². This will be the limitations for the scope of the tests

Video – Fire Test - Test Series 2



Fire test (Wood Crib 3,4m) – 1 minute pre-burn time with heptane. Nozzles from side

Fire tests – Test Series 4 & 5

Application – Local protection of mechanical machines + Surrounding areas next to machines

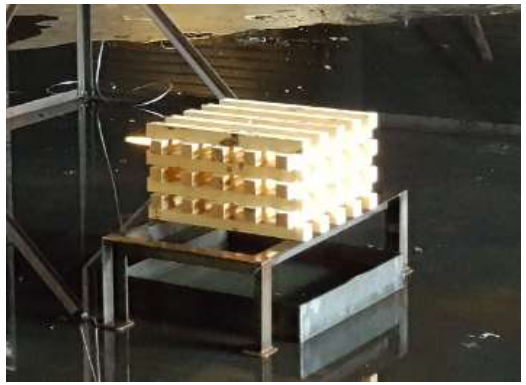
Example of real applications:

- Tissue machines
- Converting machines
- Planers, Sanders trim saw etc
- Mills
- Presses
- Etc

Fuel:

Class A Fire (wood crib)

Class B Fire (Diesel DO)



Fire tests – Test Series 4 & 5

Application – Local protection of mechanical machines + Surrounding areas next to machines

Nozzle Locations

- Water mist spray from above
  - One nozzle
  - Two nozzles
  - Four nozzle

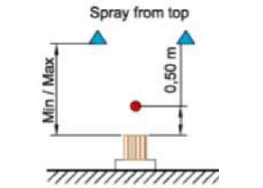
- Water mist from the side

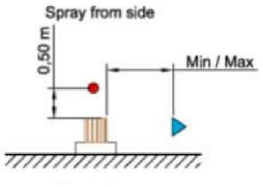
✓ Min/max installation height/distance from the risk area to be tested

✓ Max nozzle spacing to be tested

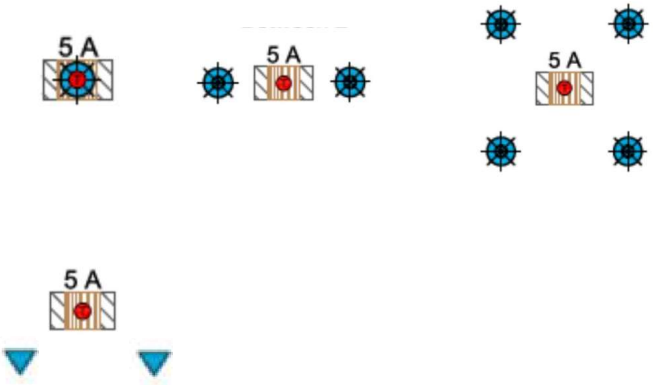
- Scalable Solution

Side Views





Top Views



Test series 8 – comparison fuel test

The purpose of this test series is to compare the class A-fuel load used in test series 1-7 to a real life fire risk. Typical values to compare on:

- Fire growth speed
- Flame height
- HRR development and peak HRR (Heat Release Rate)

=

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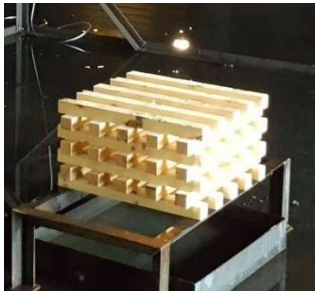
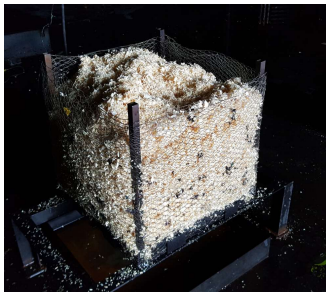
Test series 8 – comparison fuel test

	Wood Crib (50x50x50)	Wood Crib (27x50x50)	Wood Pellets (50x50x50)	RDF (Waste) (50x50x50)	Wood Shavings (50x50x50)
					
Flame Size After 120s	3-3.5 m	2-2.5 m	<1 m	<1 m	<1 m

Test series 9 - Verification of Response time

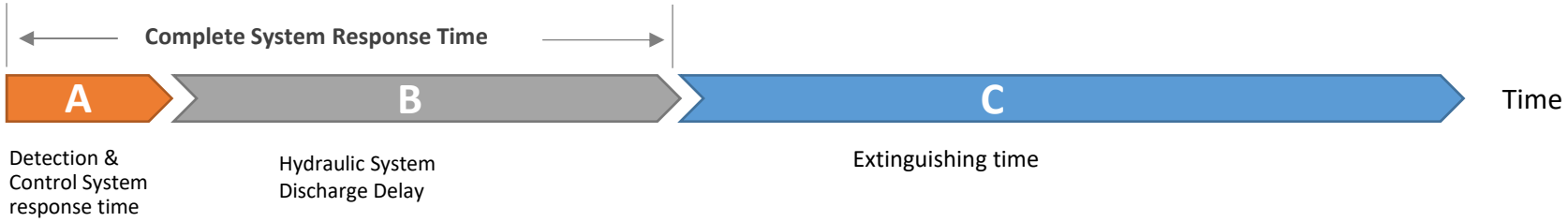
The maximum accepted 'Complete System Response Time' is 5 seconds for all fire tests except for test series 3 for conveyors, which is 30 seconds

Definitions

A) Detection and control system response time = Response time of flame detectors including delay time in control system

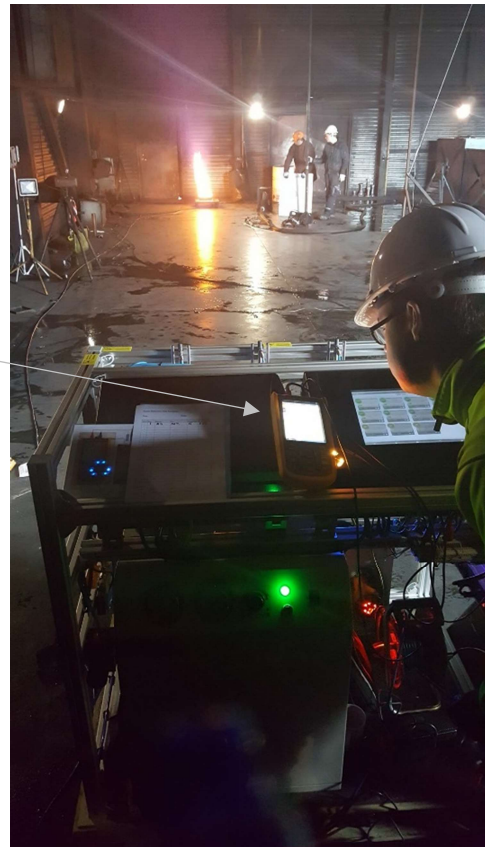
B) Hydraulic system discharge delay = Time from the signal is given to activate the suppression system until the correct amount of water at the minimum needed water pressure is supplied to the correct nozzle(s)

Complete system response time = A + B



Verification of System Response Time

Test Rig for verification of Detection &
Control Unit response time



All parts must be successfully component tested

As a part of passing this test method all nozzles, detectors and control units must be successfully component tested according to the following standards:

Nozzles: FM5560, IMO 1165, IMO A800 MSC 265(84), TS14972 or equivalent

Control Units: EN54-2, ANSI FM 3265 or equivalent

Detectors: EN54-10, ANSI FM 3260/3265 or equivalent, where detection performance tests are included

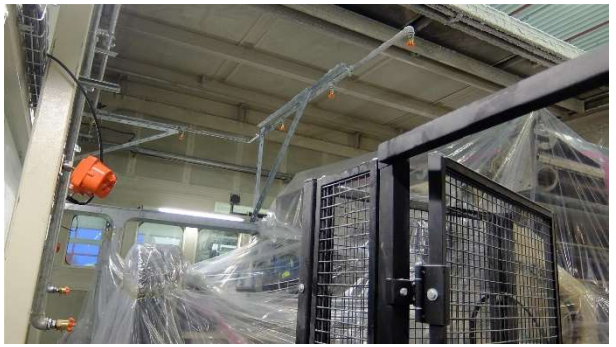
Risk Assessment – Important part of the Quick Suppression System Concept

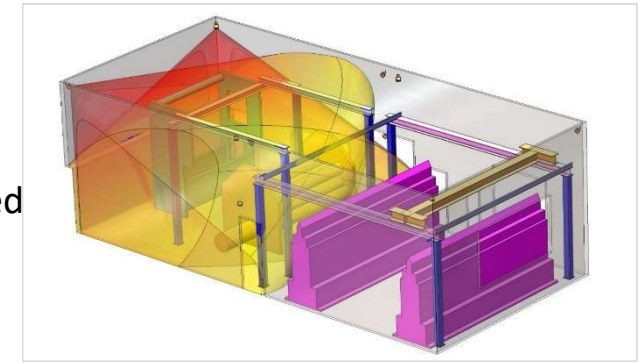
In order to achieve maximum system performance, each supply of a quick Suppression System shall be preceded be a Risk Assessment of the machine or risk area

Important factors in the Risk Assessment:

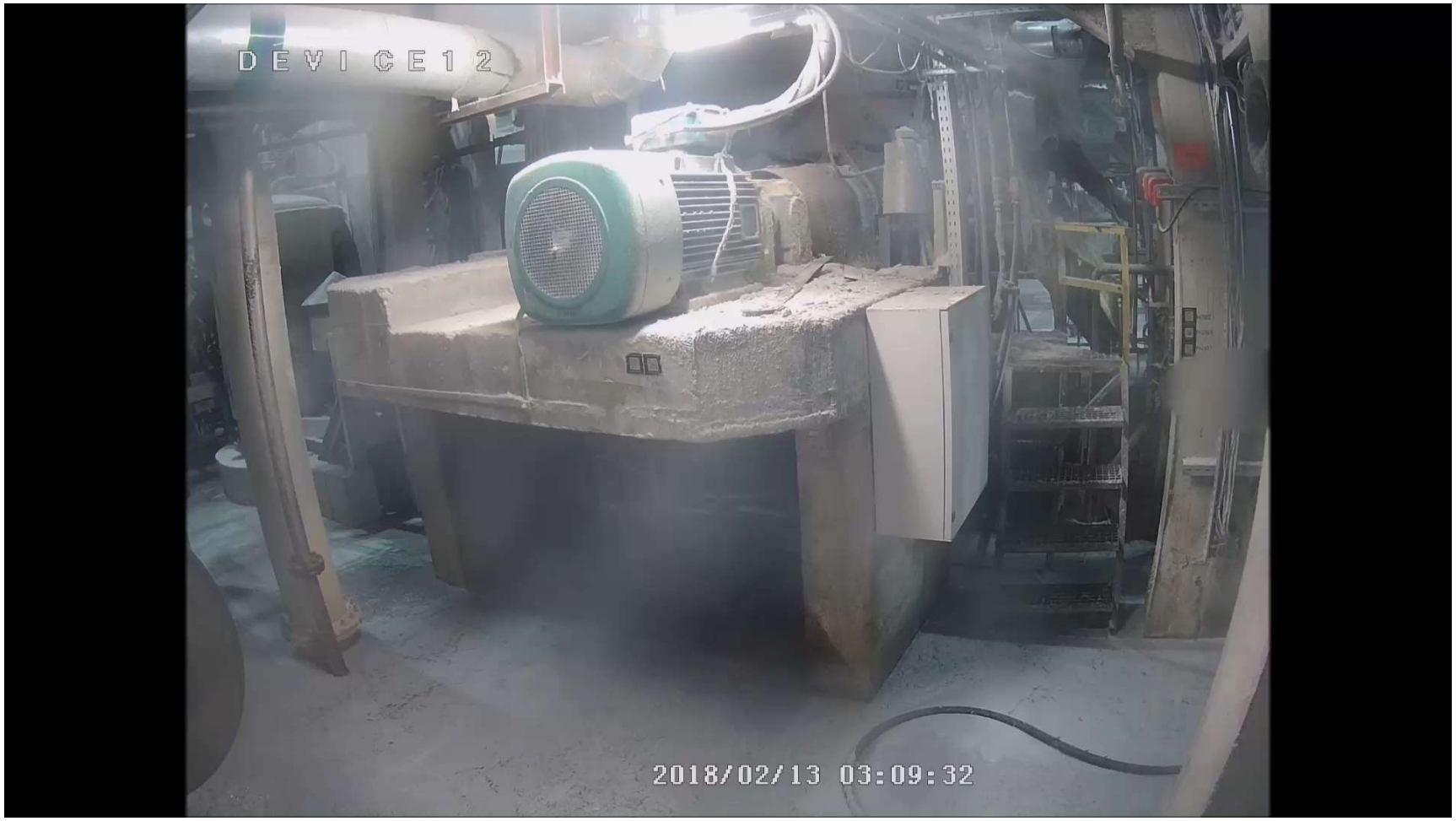
- ✓ Fuel types
- ✓ Machine design / Machine dimensions
- ✓ Room dimensions
- ✓ The Defined Risk Area (DFA) must be determined
- ✓ Ventilation conditions
- ✓ Ignition points / risks

The positioning of water mist nozzles and detectors will be done, based on the RA, where the detection coverage area will also be specified





Real case - Video from a Firefly Quick Suppression System in action



Conclusion

General

- ✓ There are many non-certified fire protection systems in the market – large need for test protocols suitable for specific applications and risks
- ✓ A quick system response time is very important when protecting high risk machines or high risk areas – High value for the customer
- ✓ Important to involve experts with various background and different competence areas
- ✓ The DFL 170307-1261 is an open test protocol, available for everyone to use

When testing against DFL TM170307-1261

- ✓ Make sure you have a plan over which type of machines / applications you want to protect
- ✓ Is the DFL TM170307-1261 applicable for your applications and risks?
- ✓ Which products and system design shall be tested?
- ✓ Invest time in studying the machines and applications carefully before conducting the tests

QUESTIONS?

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