# How to recognize a good fire test protocol?

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# Introduction

**Topics we will look into:**

- Short introduction of DGMR
- The essence of fire testing
- Process of developing a fire test procedure
- Materials using in a test?
- Performance criteria
- Pass/fall criteria
- Questions

**Note:**

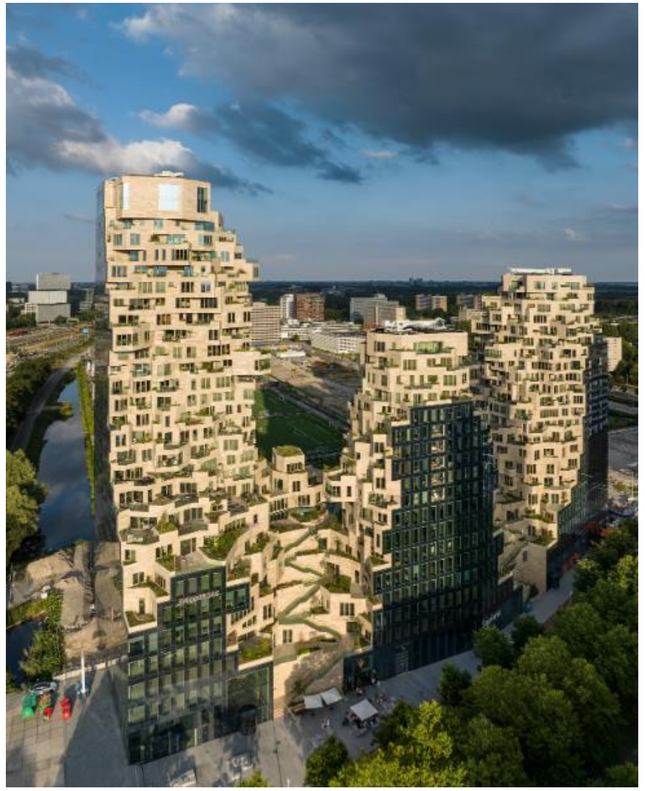
- Based on experience in The Netherlands
- All projects should be considered individually

# Introduction DGMR

**3** offices
**260+** employees
**2.000** projects per year
**€ 25.000.000** turnover

Consultancy services:

- Acoustics and sound
- Building Physics
- **Fire safety**
- Security
- Sustainability and Health
- Facade Technology
- Spatial Planning and Environment
- Vibration control
- Software



The Valley - Amsterdam

Rijks Museum - Amsterdam


Van Gogh Museum - Amsterdam

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# The need for fire testing?

## Why fire testing?

Answer to a certain question and the answer is not available based on existing information.

*“confirmation of reliability/certainty”*

**For water mist let’s make this question simpler:**

Verify that:

- For: a certain hazard (e.g. fire load and fire behavior)

  +

- In: a certain room (e.g. floor area/height/ventilation)

  +

- With: certain installation design (e.g. nozzles type / spacing / water application rate)

  =

  **predefined performances will be achieved**

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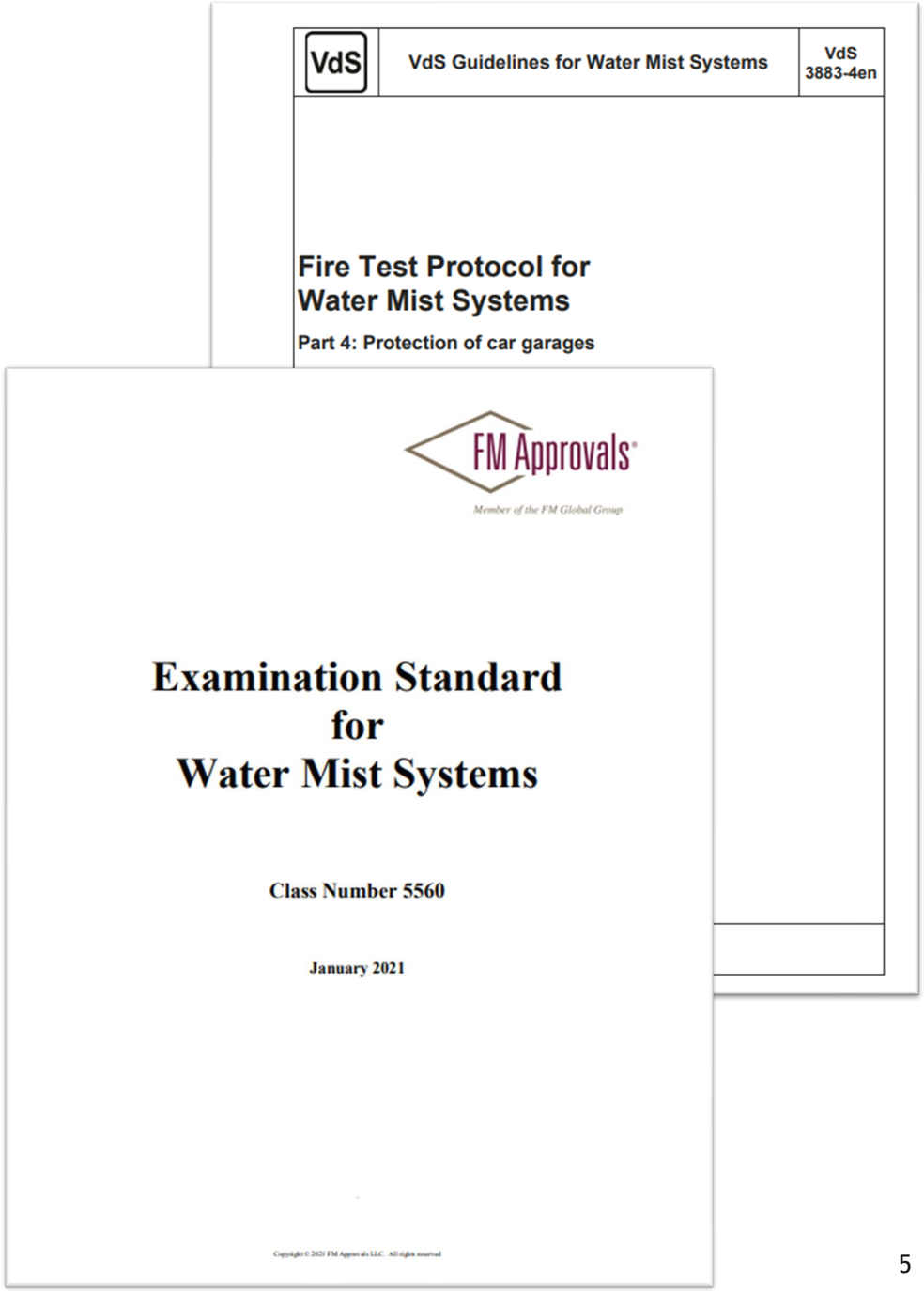
# The need for fire testing?

**For a lot of regular situations, fire test protocols are available:**

- EN 14972 series (based on VdS/LPCB+DFL+FM approvals/ISO)
- UL
- FM
- VdS

**Often situations don't match an existing test protocol, options:**

- It 'almost looks the same', we have safety margins so it will be fine.
- Full scale fire test



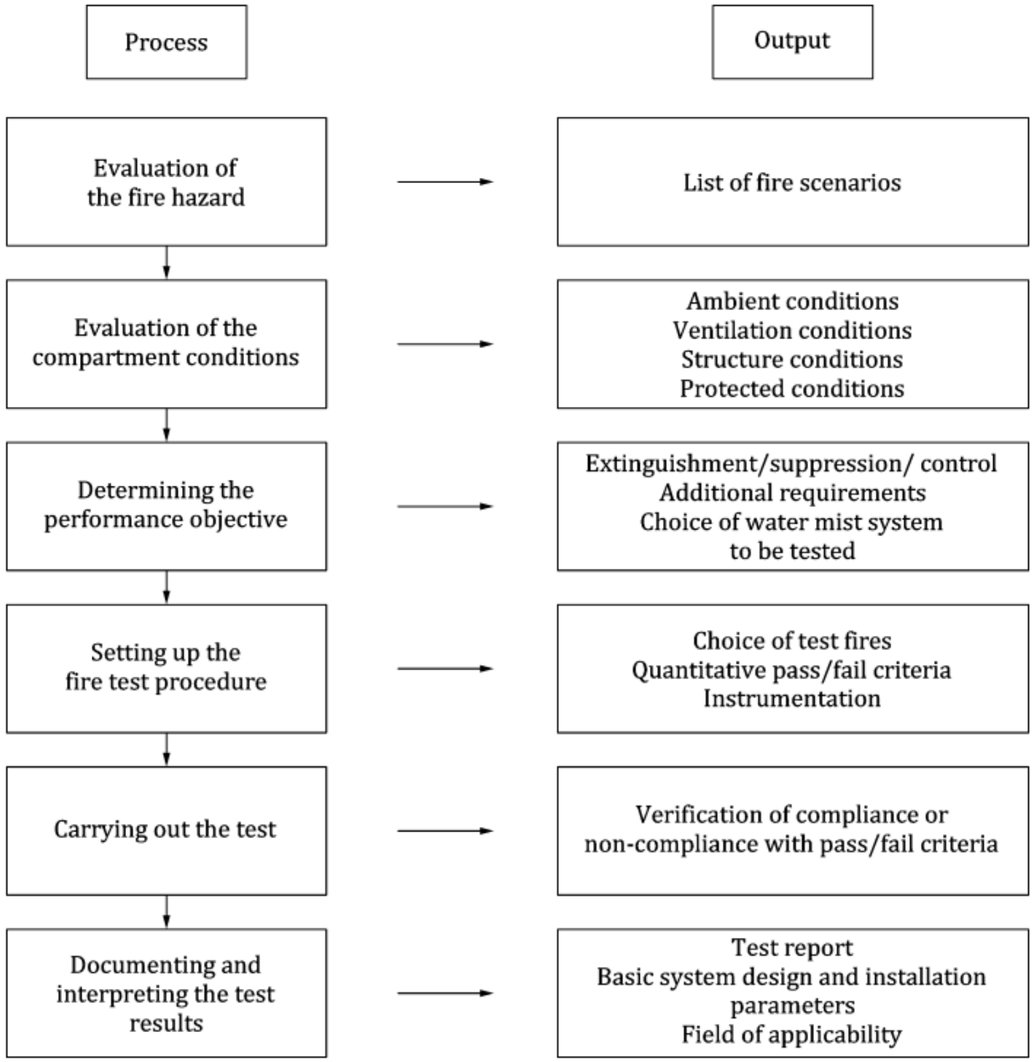
# Process of developing a fire test procedure

**Annex A.2 of EN 14972-1 contains useful information to create a specific fire test protocol.**
**In general, we see two options:**

- Adapt an existing protocol
- Create an entirely new protocol

**Some important aspects we will discuss:**

- Performance criteria
- Materials to be used
- Pass/fail criteria and how to observe these



# Performance criteria

**The required performance should be well defined, some examples:**

- Suppression or control a fire
- Extinguish a fire
- Life safety
- Protecting structures
- Flash-over prevention
- … maybe others

**These aspect should be translated to:**

- Test setup
- Fire fuel scenario
- Aspects to be measured during the fire test
- Pass/fail criteria

# Performance criteria – example 1

## Example from an existing test protocol:

| Aspect | Applicable |
|---|---|
| structural integrity Building | Yes |
| damage to sensitive equipment or systems | No |
| smoke damage | Yes, for lifestock |
| water damage | No |
| visibility | No |
| tenability | Yes |
| flash-over prevention | n/a |

Mandatory registrations during the test in seconds are:

- Time of activation of the heptane
- Pre burning time (catalyst / igniter)
- Free burning time
- Time of initial activation of the fire protection system
- End of the suppletion of the fire protection media
- Time at which the flames are extinguished (if possible)
- Soak time of the total flooding system

The performance requirement for large fires in stables based on the typical hazard configuration as found today in these stables (Ordinary Hazard class stables). The fire protection system shall meet the assessments for OH stable. The fire protection system configuration in this specific certification program is based on a total flooding deluge watermist system. The goal of the test is fire suppression.

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# Performance criteria – example 2

**Example from an existing test protocol:**

This standard states testing and certification requirements for water mist systems for use as fire control systems.

- No more than five nozzles shall operate and at least one nozzle shall remain un-actuated beyond each operating nozzle.
- Damage to Fuel Package shall not exceed 50 percent by volume or dry weight.
- The maximum ceiling surface temperature over ignition is not to exceed 500°F (260°C).
- In addition, the maximum gas temperature over ignition 3 in. (76 mm) below the ceiling is not to exceed 600°F (315°C).

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# Pass / Fail Criteria

## Pass/fail criteria should be used to determine whether performance criteria are met. Some examples of pass/fail criteria:

**Visual observations:**

- Damage to fuel package by volume
- Damage to fuel package by dry weight
- % of surface damaged by fire
- Max. size of the fire
- Max. flame heights
- Max. horizontal flame spread
- Not reach end of storage rack / cable tray

**Measured observations:**

- Temperature (peak/average)
- Flow
- Pressure
- Weight loss
- Fire extinguished in x minutes
- Heat release


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# Pass / Fail Criteria

**Example:**

1. No more than five nozzles shall operate and at least one nozzle shall remain un-actuated beyond each operating nozzle. ✅
2. Damage to Fuel Package shall not exceed 50 percent by volume or dry weight.
3. The maximum ceiling surface temperature over ignition is not to exceed 500°F (260°C). ✅
4. In addition, the maximum gas temperature over ignition 3 in. (76 mm) below the ceiling is not to exceed 600°F (315°C). ✅

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# Pass / Fail Criteria

**Pass/fail criteria:**

- Damage to Fuel Package shall not exceed 50 percent by volume or dry weight.

**What is damage?**

- Burned parts?
- parts that are black, but is this burnt or soot deposits?
- Often a group of experts look at the product to make a combined conclusion

**How to weight a product:**

- Probably more wet than before testing

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# Pass / Fail Criteria

**Pass/fail criteria:**

- No more than five nozzles shall operate and at least one nozzle shall remain un-actuated beyond each operating nozzle.
- The maximum ceiling surface temperature over ignition is not to exceed 500°F (260°C).
- In addition, the maximum gas temperature over ignition 3 in. (76 mm) below the ceiling is not to exceed 600°F (315°C).

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# Flames

**Pass/fail criteria:**

- The fire cannot spread to either end of the loaded cable tray.

**How?**

- What is fire: flame/smoke/smoldering?
- How to observe: visual (1 person, x people), camera, infrared, with or without ruler, view angle, time period?

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# Materials to be used

**Repeatability:**

- If tests are run multiple times, similar results should come out;
- Tests performed in different test labs should give comparable results;

**From fire scenario to fire load**

- The real-world fire scenario should be translated to a representative test fire load

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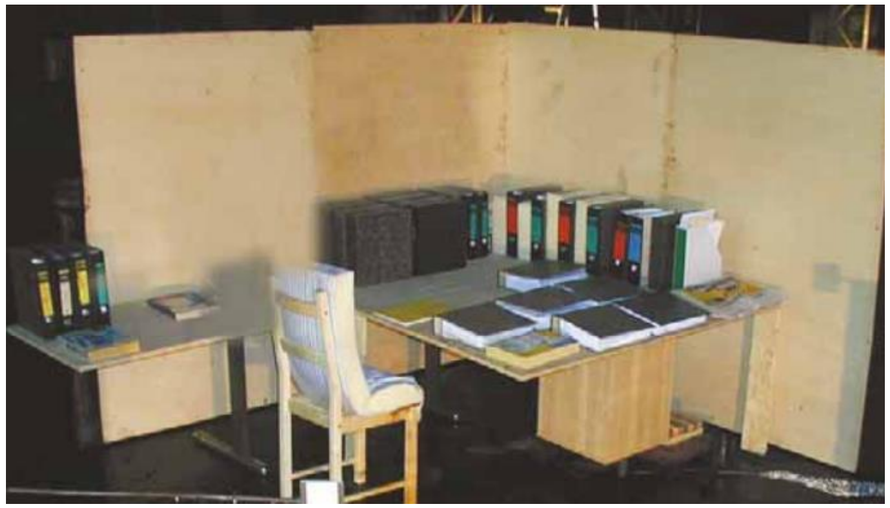
# Materials to be used

## Materials in fire test:

| Fuel package | + | - |
|---|---|---|
| Materials as present in real-world situation | Easy setup, looks like real-world situation | Results of multiple test can differ more |
| More simulated setup | Results of multiple are more comparable | Harder to design fuel package |



# Materials to be used

**Materials in fire test:**

- Is a brand X chair in 2024 the same chair as in 2025?
- Is a brand X chair in the UK the same chair as in Holland?

**Material specifications:**

- In the fire test protocol, a good description of fuel package should be given
- Products should be easy obtainable
- Products should be from comparable specifications independent were purchased

**Is spruce wood from Scandinavia the same as from Hungary?**

# Materials to be used

## Example of a fire test fuel description:

*The fuel for the fire cell for this test:*
*2 plates of EPS isolation material with minimal of 2% polystyrene with the dimensions 120 x 60 x 5 cm. These plates are mounted mechanically on the bottom of a plate with a class A according to EN13501-2. The combination of these plates have been conditioned at ambient room conditions for at least 24 hours.*

## EPS:

- Dimension: 120 * 60 * 5 cm
- > 2% Polystyrene

## Unclear

- Nothing about weight of the product
- Datasheets don't mention Polystyrene content
- Fire retardants allowed or not?

| Physical Properties | EPS 70 | EPS 100 | EPS 150 | EPS 200 | EPS 250 | EPS 300 | EPS 350 | EPS 400 | EPS 500 | Plus-Therm |
|---|---|---|---|---|---|---|---|---|---|---|
| **Thermal Conductivity** (W/mK) | 0.038 | 0.036 | 0.034 | 0.034 | 0.034 | 0.034 | 0.034 | 0.034 | 0.034 | 0.030 |
| **Compressive Strength @ 10%** (kPa) | 70 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 500 | 100 |
| **Nominal Density** (kg/m3) | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 60 | 20 |
| **Bending Strength** (kPa) | 115 | 150 | 200 | 250 | 350 | 450 | 525 | 600 | 750 | 150 |
| **Water Vapour Permeability** (mg Pa.h.m) | 0.015 - 0.030 | 0.009 - 0.020 | 0.009 - 0.020 | 0.006 - 0.015 | 0.006 - 0.015 | 0.006 - 0.015 | 0.006 - 0.015 | 0.006 - 0.015 | 0.006 - 0.015 | 0.009 - 0.020 |
| **Water Vapour Diffusion Resistance** (μ) | 20-40 | 30-70 | 30-70 | 40-100 | 40-100 | 40-100 | 40-100 | 40-100 | 40-100 | 30-70 |
| **Reaction to Fire - Standard EPS** | F | F | F | F | F | F | F | F | F | E |
| **Reaction to Fire - Fire Rated EPS** | E | E | E | E | E | E | E | E | E | E |
| **Length Tolerance** | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 |
| **Width Tolerance** | W2 | W2 | W2 | W2 | W2 | W2 | W2 | W2 | W2 | W2 |
| **Thickness Tolerance** | T2 | T2 | T2 | T2 | T2 | T2 | T2 | T2 | T2 | T2 |
| **Flatness Tolerance** | P5 | P5 | P3 | P3 | P3 | P3 | P3 | P3 | P3 | P5 |
| **Squareness** | S2 | S2 | S2 | S2 | S2 | S2 | S2 | S2 | S2 | S2 |
| **Dimensional Stability** | DS (N) 5 | DS (N) 5 | DS (N) 5 | DS (N) 5 | DS (N) 5 | DS (N) 5 | DS (N) 5 | DS (N) 5 | DS (N) 5 | DS (N) 5 |

# Conclusions

*“A weak test protocol can never lead to reliable fire protection”*

**You can recognize a good testing protocol by:**

- clearly defined objectives
- clear pass/fail criteria
- full description of the materials to be used in the test

Annex A.2 of EN 14972-1 can help by formulating or assessing a test protocol/testing results.

Important: relationship between the objectives, pass/fail criteria and aspects that are ‘measured’ during a test.

# Questions

## Thank you

## Questions?

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