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STORHY

Overview of requirements for destructive hydrogen container tests

STORHY FINAL EVENT
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JRC EUROPEAN COMMISSION

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Scope

In the frame of StorHy Sub Project SAR a synoptic table has been prepared, mapping destructive tests for hydrogen containers (vessels, tanks) as prescribed by international standards and/or regulations.

Purpose of the work is a detailed compilation of existing (drafted or approved) testing requirements, to be compared with the results of SP SAR activities focussing on Probabilistic approaches.

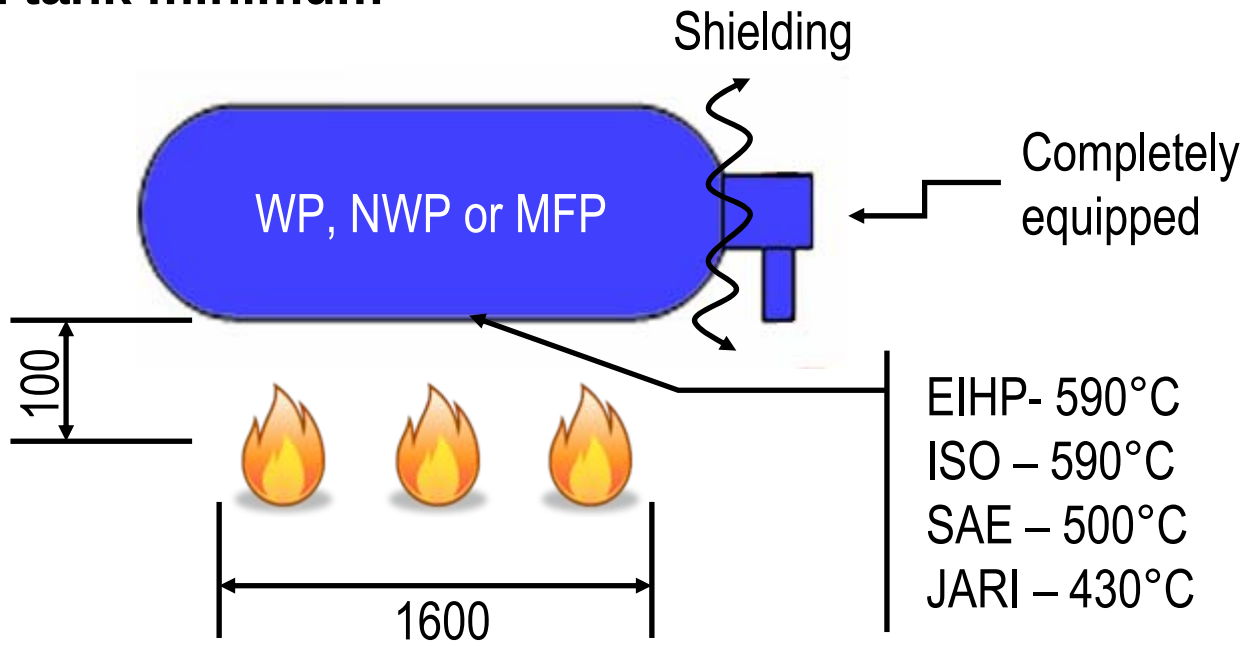
Regulations used

The following standards/regulations have been used:

- **EIHP II – U*niform provisions concerning the approval of …specific components of motor vehicles using compressed gaseous hydrogen (2004).***
- **ISO/DIS 15869 - *Gaseous hydrogen and hydrogen blends, land vehicle fuel tanks (2006)***
- **SAE J2579 - *Technical information Report for Fuel Systems in FC and other hydrogen vehicles (draft 2007 + 2008)***
- **JARI S 001 - *Japanese regulation for containers of compressed hydrogen vehicle fuel devices (2004)***

Bonfire test

☞ **Sampling: 1 tank minimum** ☜



To be monitored

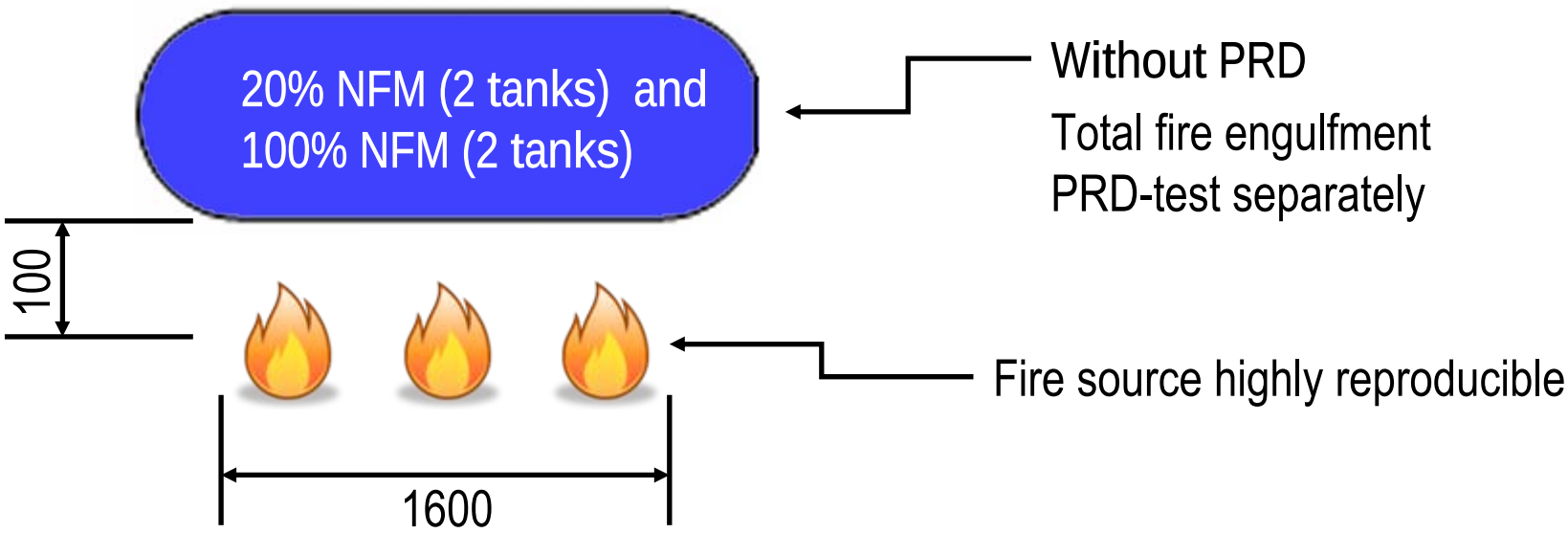
Time to pressure equal:
EIHP, ISO, SAE – 1 MPa
JARI – 0.69 MPa

Approval

gas release without burst, only through PRD

Bonfire test: Probabilistic Approach

☞ **Sampling: 4 tanks minimum** ☜

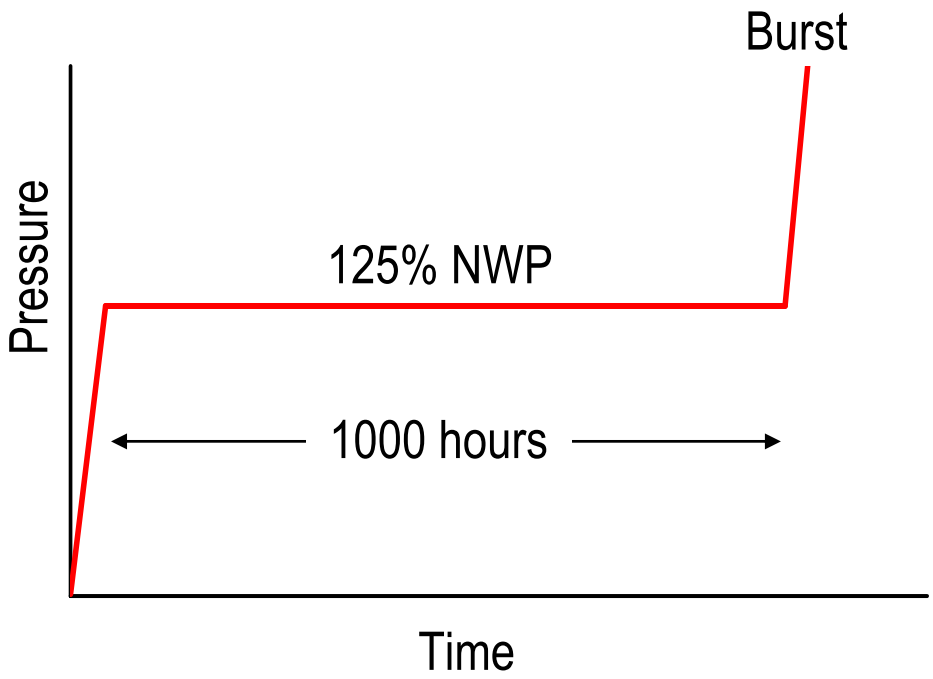


Approval:
PRD to be chosen based on mass flow-pressure-performance so that that the time to 1 MPa is
≤1/2 time to burst at 20% WP
≤ time to burst at 100% WP

Stress Rupture Test

(extended static high pressure)

☞ **Sampling: 1 tank minimum** ☜



Fluid

ISO and JARI: fluid (no gas)

SAE: hydrogen (part of Exp. Service Life Performance Test)

Temperature

EIPH, ISO and SAE: 85°C

SAE: ≥65°C

Approval

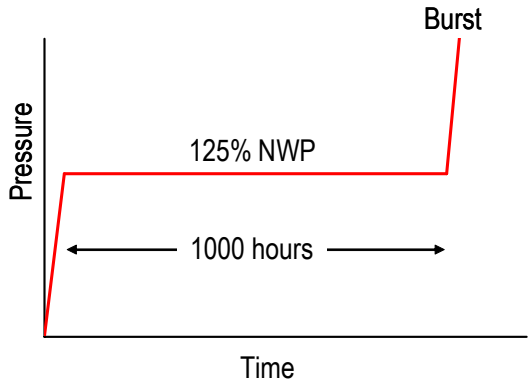
ISO : ≥ 85% min design burst pressure

JARI: ≥ 75% min design burst pressure

SAE: test only part of combined test procedure

Stress Rupture: Probabilistic Approach

☞ **Sampling: 3 to 6 tanks** ☜

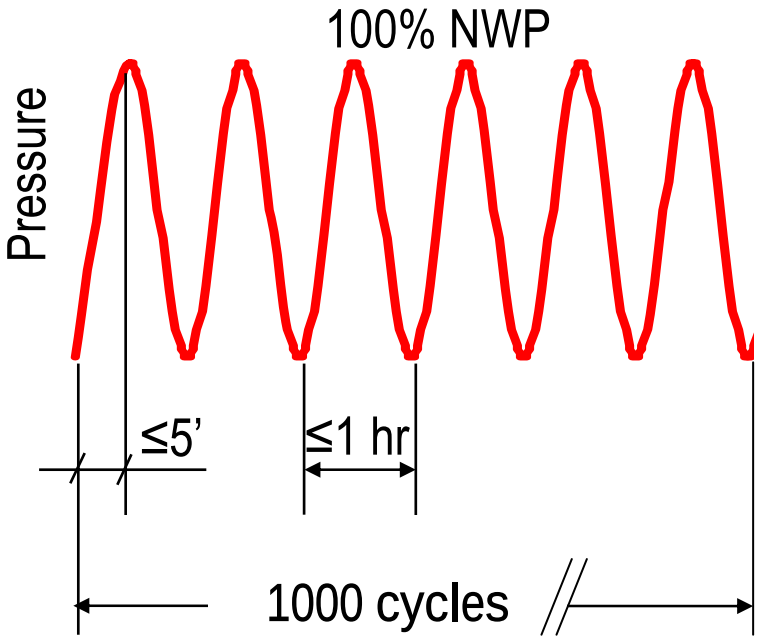


Approval

resulting burst pressure has to meet the minimum operating data at a reliability level of 99,9999% for total failure and 99,99% for leakage

Example: H2 cycling test

☞ **Sampling: 1 tank minimum** ☜



ISO required 24 hr static pressure period each 100 cycles

Approval

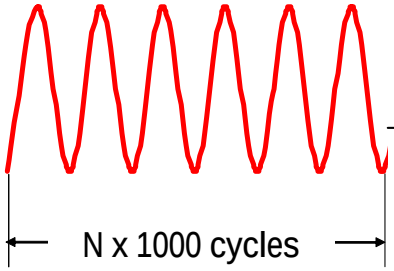
EIHP and ISO: no leakage, permeation rate permissible

JARI: ≥ no leakage, no visible deterioration

SAE: test only part of combined test procedure

H2 cycling: Probabilistic Approach

☞ **Sampling: 3 tanks 1000, 2000, 3000 cycles each**



Each 100 cycles sustained pressure for 24 hr

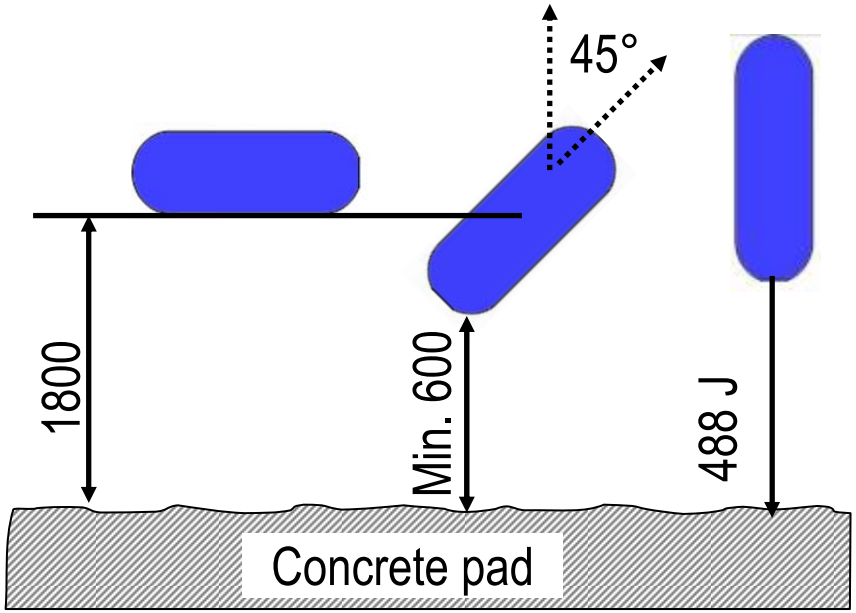
Permeation test (type IV only)

hydraulic extreme temperature cycle test at +85°C

<u>Approval</u>

Fulfilment of maximum permeation rate condition and demonstration of good relationship of hydraulic and gaseous cycling

Impact damage



☞ **Sampling: 1 tank minimum** ☜

<u>Approval</u>: no leakage (exception ISO)

Followed by:

<u>EIHP</u>: 3x 5000 cycles 2 MPa to 125% NWP

<u>ISO:</u> 3000 cycles 2 MPa to 125% WP (+12000 cycles)

<u>SAE:</u> 1000 cycles 2 MPa to 125% NWP

<u>JARI:</u> 11250 cycles 2 MPa to 125% MFP

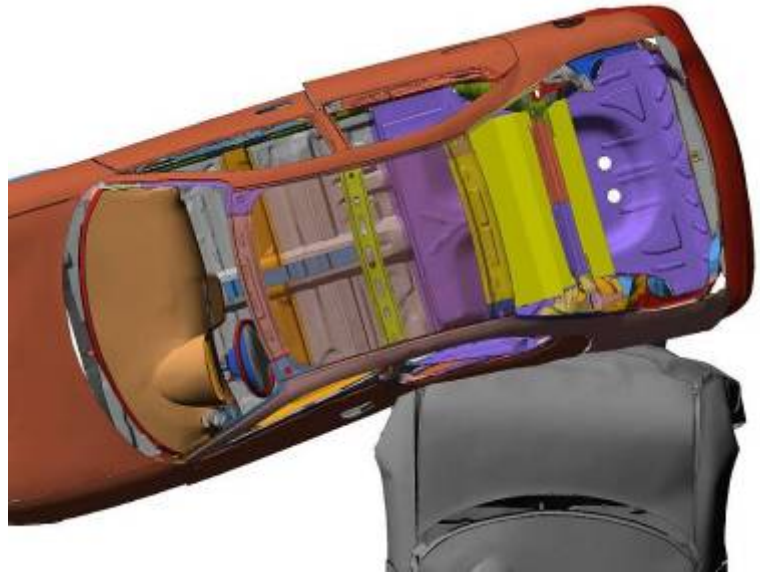
…and the crash aspects?

SAR proposal:

☞Sampling: 4 tanks minimum ☜

20% Nominal Filling Mass (2 tanks)

100% NFM (2 tanks)



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- Impact mass drop height and geometry resulted from crash simulation of FE-Model; single validation vehicle test with gas filled tanks
- approved by sufficient demonstration of resistance against burst under all conditions of crash accidents given by a level of reliability required by the country of use; taking into account accident statistics of the country of use (or harmonised figures); these figures may differ depending on WP