Jet fires effects: experimental studies

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Jet fires effects: experimental studies

Outline

- Objectives
- Tests matrix
- Means of tests
- Timeline
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Objectives

- Effect of TPRD fire on vehicle fire dynamics in tunnel

- Studied criteria
  - Impact of ventilation
  - Impact of the release direction
  - Impact of TPRD diameters
  - Fire characteristics

- Measured parameters
  - Pressure, temperatures
  - Heat fluxes
  - Gases concentrations (H₂, He, O₂, CO₂, CO)
  - Cameras

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Tests synopsis

TPRD  no
  yes
  Selected diameters = 0.5 / 1 / 2 / 3 / 4

Fire  no
  yes
  Test 3

H₂  no
  yes
  Ventilation

  no
  yes
  Upwardly oriented

  no
  yes
  Test 5

  Test 6

He,N₂  no
  yes
  Test 2

H₂  yes
  Test 11

See tests in section tank rupture

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Means of testing: Tunnel

- **7 priority tests**

<table>
<thead>
<tr>
<th>Test N°</th>
<th>Description</th>
<th>Gas</th>
<th>TPRD</th>
<th>Vehicle</th>
<th>Ventilation</th>
<th>Goal / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Devices qualification tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Reproduce one of the pre-tests for validation</td>
</tr>
<tr>
<td>1</td>
<td>Jet fire – Reference test: Ignited jet and fire: H₂ jet on fire (burner type) with downwardly oriented TPRD</td>
<td>H₂</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Accident/ Referent scenario. 700 bar as nominal value With ventilation and smoke (TPRD to be pick up for tests 1 and 12)</td>
</tr>
<tr>
<td>2</td>
<td>Unignited gas dispersion in a tunnel</td>
<td>He</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>No fire, concentration measurements along the tunnel (Prepare the ignition of test 8, bench CFD)</td>
</tr>
<tr>
<td>3</td>
<td>Characterization of a single fire as test 1</td>
<td>-</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Fire burner alone with smoke, ventilated tunnel Thermal flux measurements and smoke dispersion</td>
</tr>
<tr>
<td>4</td>
<td>Jet fire / Test 1 without ventilation</td>
<td>H₂</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>H₂ jet test on fire with smoke, non ventilated tunnel, downwardly oriented TPRD - Impact of the ventilation (tests 1 and 4) - H₂ impact on fire (tests 3 and 4)</td>
</tr>
<tr>
<td>5</td>
<td>Jet fire / Effect of TPRD orientation</td>
<td>H₂</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>H₂ jet test on fire with smoke, ventilated tunnel, upwardly oriented TPRD TPRD orientation impact (tests 1 and 4)</td>
</tr>
<tr>
<td>6</td>
<td>Jet fire / Reproducibility of test 1</td>
<td>H₂</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Repeatability of the reference test. Second reference test (same as test 1)</td>
</tr>
</tbody>
</table>

- **Two campaigns**
  - Pre – tests campaign Q2/2020
  - Nominal Testing campaign Q4/2020
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Means of testing : Tunnel

<table>
<thead>
<tr>
<th>Tunnel data</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>110 m (4 km total)</td>
</tr>
<tr>
<td>High</td>
<td>7.5m mean. (7.2 to 8m)</td>
</tr>
<tr>
<td>Width</td>
<td>11.2</td>
</tr>
<tr>
<td>Gradient, Slope</td>
<td>0 %</td>
</tr>
<tr>
<td>Section</td>
<td>70.5 m²</td>
</tr>
<tr>
<td>Volume</td>
<td>7,760 m³</td>
</tr>
<tr>
<td>Ventilation flow</td>
<td>138,000 m³/h</td>
</tr>
<tr>
<td>Average air speed</td>
<td>0.54 m/s</td>
</tr>
<tr>
<td>Air change rate</td>
<td>Up to 17,8 times/h</td>
</tr>
</tbody>
</table>
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Means of testing: Gas injection

- Size of fictive “SUV body frame”
  - 1.9 m x 4.5 m x 0.2m

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Means of testing: testing configuration

HYTUNNEL – Pre-tests campaign

Gallery test location plan

Burner

1m² - 870 kW
(0.87 MW/m²)
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Conclusions and further work

- 46 fire tests planned
- Initial planning
  - March 16th to April 03rd
  - Cancelled on March 15th due to COVID-19
- New dates: June 2020 (TBC)
Acknowledgements

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