**International Topical Team**

The experiment is an international collaboration between numerous space agencies. The collaboration is managed by an International Topical Team including participation by NASA and ESA, plus a group of international scientists (pictures below). It aims to revolutionize spacecraft fire safety designs for next-generation space vehicles and habitats. It will feature a validation experiment in the pressurized interior environment of the unmanned Cygnus vehicle (Orbital Sciences) after it has completed its supply mission to the International Space Station. Currently, three flights are scheduled (Saffire I-III, corresponding to Orbital 57).

**Sample Layout Flights I and III**

The samples in Saffire I and III will be 40.6 cm by 94.0 cm of cotton / fiberglass blend (Sibral cloth) 75% cotton by weight (18.05 mg/cm²) Embedded thermocouples at 0, 0.3 and 0.8 cm above the surface in 2 locations to estimate the flame position and the standoff distance in order to compare with the video footage.

**Vehicle Configuration**

Cygnsus approaching the ISS

Cutaway view of the fire duct and avionics enclosure

Cygnsus interior

**Sample Layout Flight II**

**Saffire II Samples**

<table>
<thead>
<tr>
<th>Material</th>
<th>Sample Thickness</th>
<th>Flow (cm/s)</th>
<th>Igniter Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Flammability limit 1)</td>
<td>(SIBAL 1)</td>
<td>0.33 mm (0.013&quot;)</td>
<td>Top</td>
</tr>
<tr>
<td>(Flammability limit 2)</td>
<td>(SIBAL 2)</td>
<td>0.61 mm (0.024&quot;)</td>
<td>Bottom</td>
</tr>
<tr>
<td>(Flammability limit 3)</td>
<td>(SIBAL 3)</td>
<td>0.25 mm (0.010&quot;)</td>
<td>Bottom</td>
</tr>
<tr>
<td>Foam</td>
<td></td>
<td>1.02 mm (0.040&quot;)</td>
<td>Bottom</td>
</tr>
<tr>
<td>siliconePMMA (Flat)</td>
<td></td>
<td>0.61 mm (0.024&quot;)</td>
<td>Bottom</td>
</tr>
<tr>
<td>silicone compared to PMMA</td>
<td></td>
<td>0.61 mm (0.024&quot;)</td>
<td>Bottom</td>
</tr>
</tbody>
</table>

**Nomex Ignition Testing**

Tests have been conducted with Nomex HT90-40 to find the limiting oxygen concentration (LOC) for flame spread as a function of ambient pressure in a quiescent environment. The igniter was a hot wire: 13 V at 15A. The results with Nomex HT90-40 revealed that having a forced flow, or mixed flow over the fabric surface versus a quiescent environment resulted in different LOC values. The strong dependence on pressure suggests other kinetic effects or flow effects.

**Effect of Surface Structures**

As compared to a flat plate, a sharp edged groove can retard or enhance flame propagation - dependent on width.

PMMA-sample to be processed onboard the Cygnus-spacecraft.

**Numerical Modeling**

A detailed three-dimensional transient concurrent flame spread model, featuring an adaptive mesh refinement method that will resolve the spreading flame base and pyrolysis front, will be utilized to predict recent ISS experiments and future saffire runs.

**The Road Ahead**

The large-scale material flammability demonstration will facilitate the understanding of the long-term consequences of a potential spacecraft fire and provide data not only for the verification of detailed numerical models of such an event, but also for the development of predictive models that can assist and optimise fire prevention, response and mitigation.

The first step is to provide a predictive tools that will integrate fire safety into design and management of space vehicles. Such tools will integrate a wide range of design issues including, but not limited to, material selection, emergency response, crew training, post-fire clean-up, fire detection, fire suppression, environmental control and life support (ECLS) system design, and even atmosphere selection to provide a globally optimized solution.

Contact David Urban (david.urban@nasa.gov) and / or Grunde Jomaas (grujo@byg.dtu.dk) for more information or to express interest in participation.