EFFECTS OF BOUNDARY CONDITIONS ON MPS TESTING

Karsten Kirbach
Research Systems
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EFFECTS OF BOUNDARY CONDITIONS ON MPS

Motivation

- For development and certification of a halon replacement fire suppression system extensive testing in alignment with the MPS is necessary.
- Reference for testing and test results is the MPS Test Article at the FAA Technical Center.
- To achieve a high comparability a replica test article needs to be as similar as possible to the FAA MPS Test Article.
- The Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems is giving guidelines to build a replica test article, however some boundary conditions may not be defined in sufficient detail to achieve comparability.

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Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems (2012 Update)

John W. Reinhardt

May 2012

DOT/FAA/TC-TN12/11

This document is available to the U.S. public through the National Technical Information Services (NTIS), Springfield, Virginia 22161.

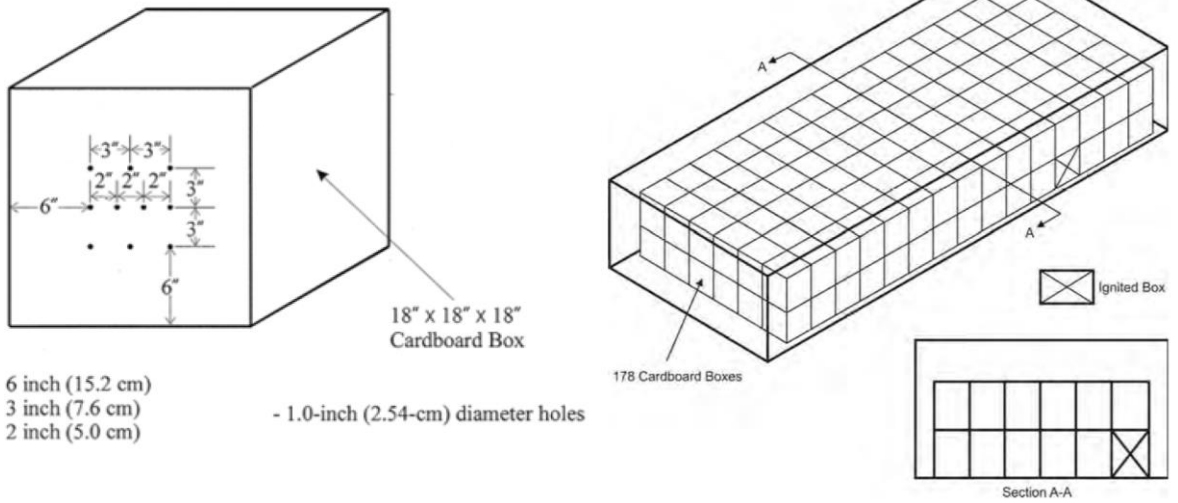
This document is also available from the Federal Aviation Administration William J. Hughes Technical Center at actlibrary.tc.faa.gov.

U.S. Department of Transportation
Federal Aviation Administration

GUIDELINES GIVEN BY THE MPS

*"The fire load [...] consists of single-wall corrugated cardboard boxes, [...] of **18 by 18 by 18 inches** (45.7 by 45.7 by 45.7 cm). The weight per unit area of the cardboard is **0.11 lb/ft2** (0.5417 kg/m2)."*

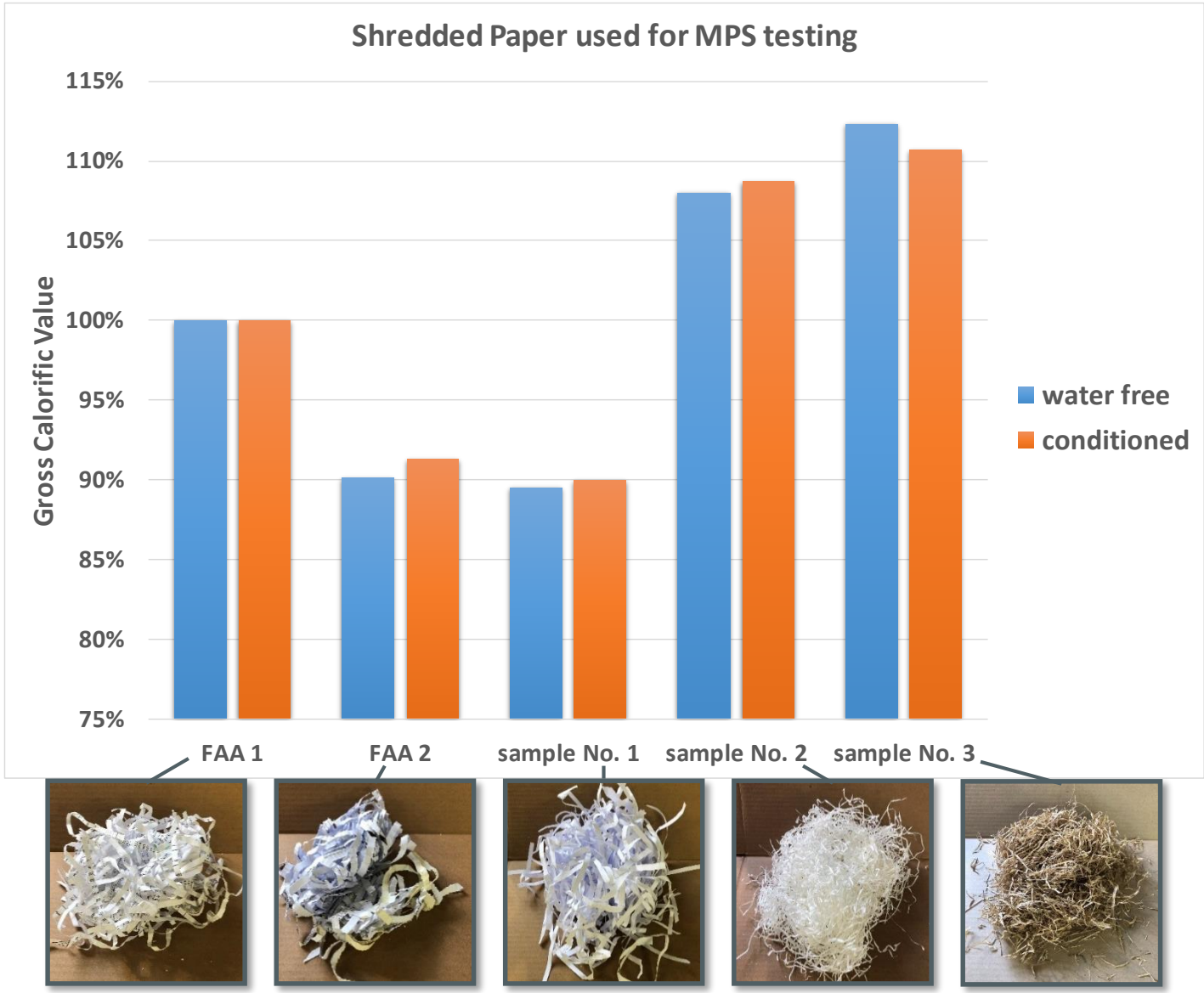
*"The boxes are filled with **2.5 pounds** (1.1 kg) of **loosely packed standard weight office paper shredded into strips** (not confetti)."*



CALORIFIC VALUE OF COMMON MPS FIRE LOADS

Shredded Paper

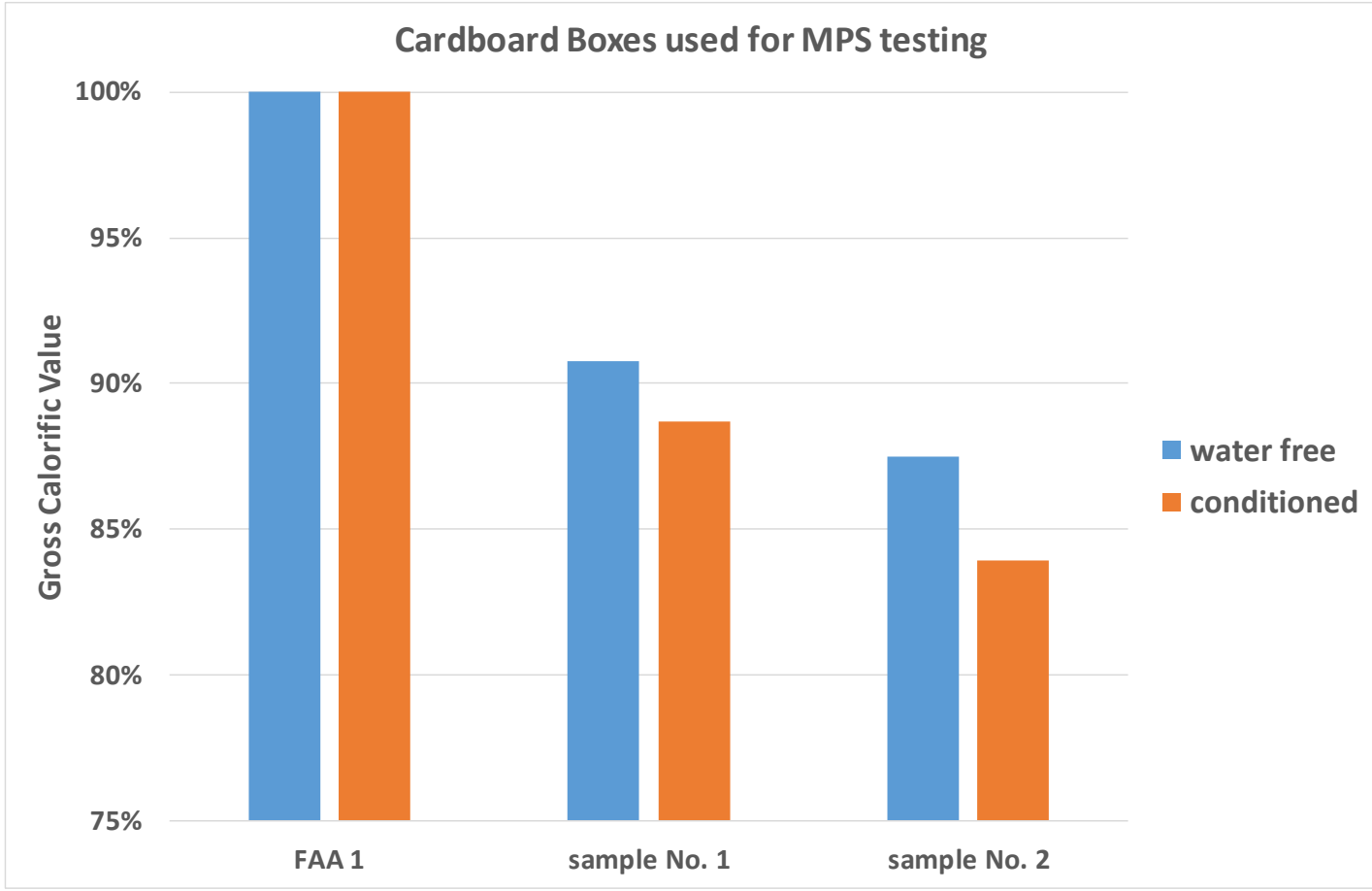
- Gross Calorific Value acc. DIN EN ISO 18125: 2017-08 „Solid biofuels - Determination of calorific value”
- Samples are grinded down and burned within a bomb calorimeter
- Samples FAA 1 and FAA 2 provided by Dhaval Dadia
- Up to **20%** difference in Gross Calorific Value



CALORIFIC VALUE OF COMMON MPS FIRE LOADS

Cardboard Boxes

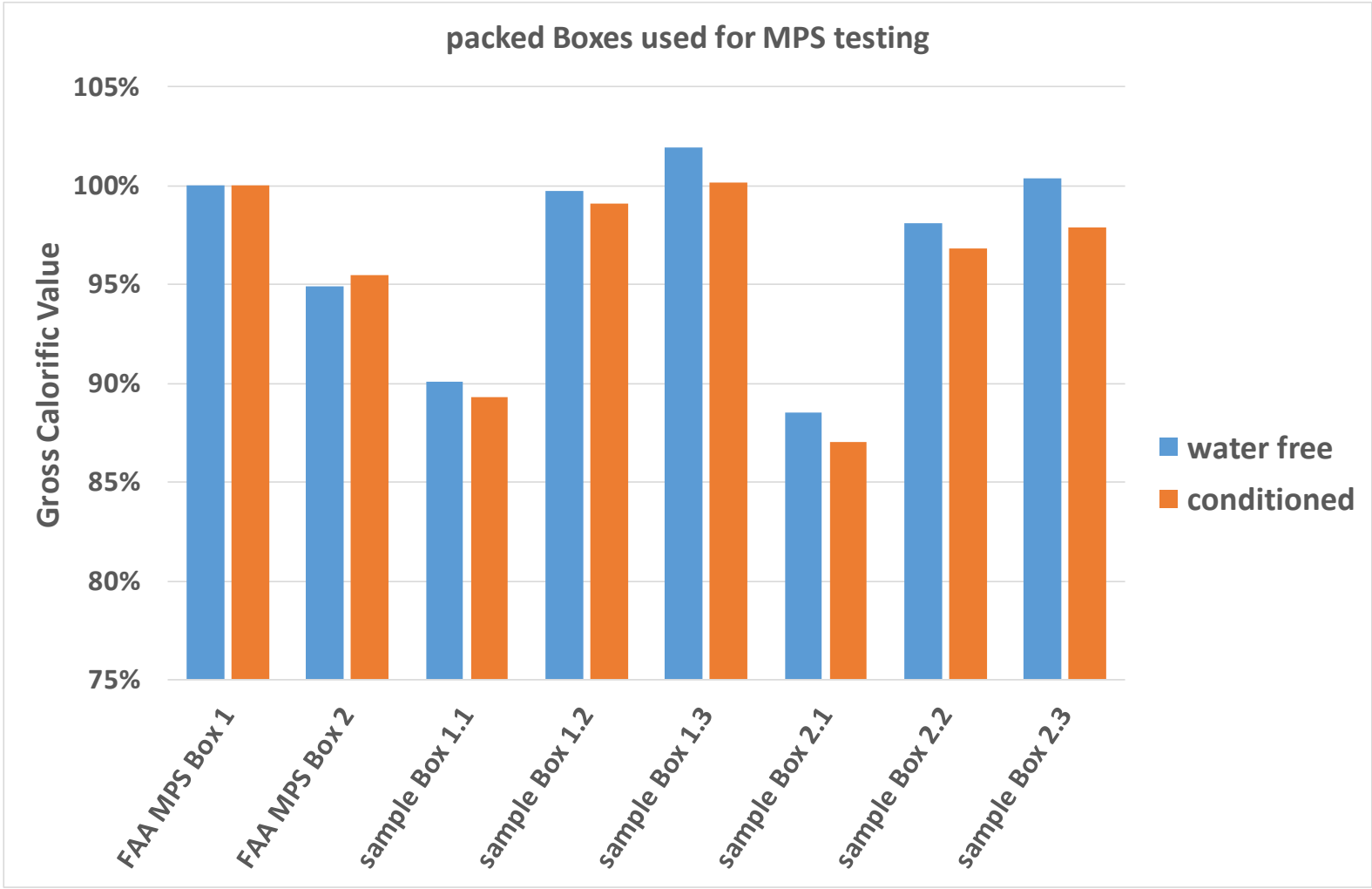
- Gross Calorific Value acc. DIN EN ISO 18125: 2017-08 „Solid biofuels - Determination of calorific value”
- Samples are grinded down and burned within a bomb calorimeter
- Samples FAA 1 provided by Dhaval Dadia
- Up to **16%** difference in Gross Calorific Value

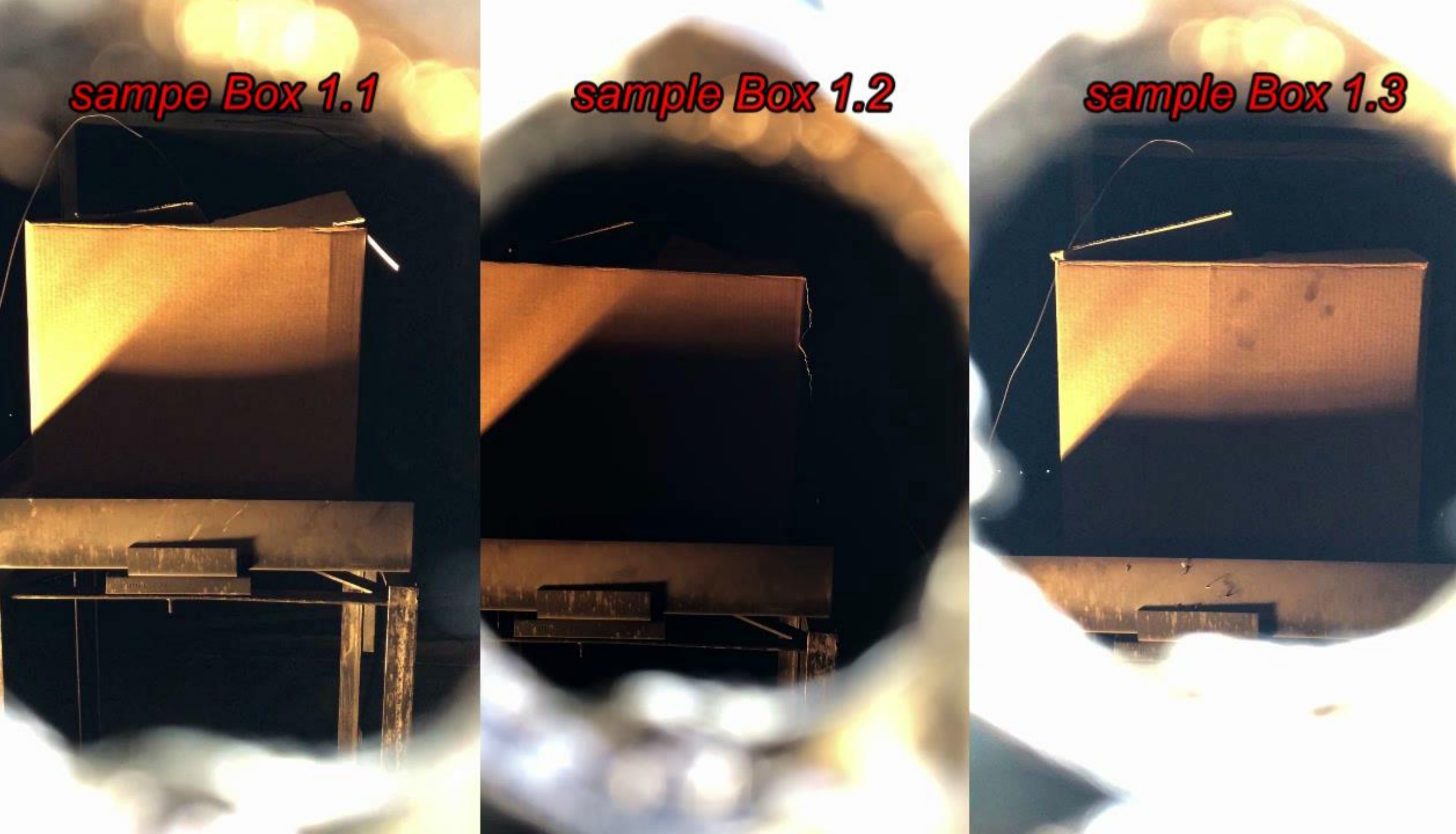


CALORIFIC VALUE OF COMMON MPS FIRE LOADS

Packed MPS Boxes

- Theoretical Gross calorific Value per packed MPS Box
- Up to **13%** difference in Gross Calorific Value
- Samples FAA MPS Box 1 and FAA MPS Box 2 provided by Dhaval Dadia
- Macroscopic combustion behavior is **not** considered!




sampe Box 1.1
sample Box 1.2
sample Box 1.3

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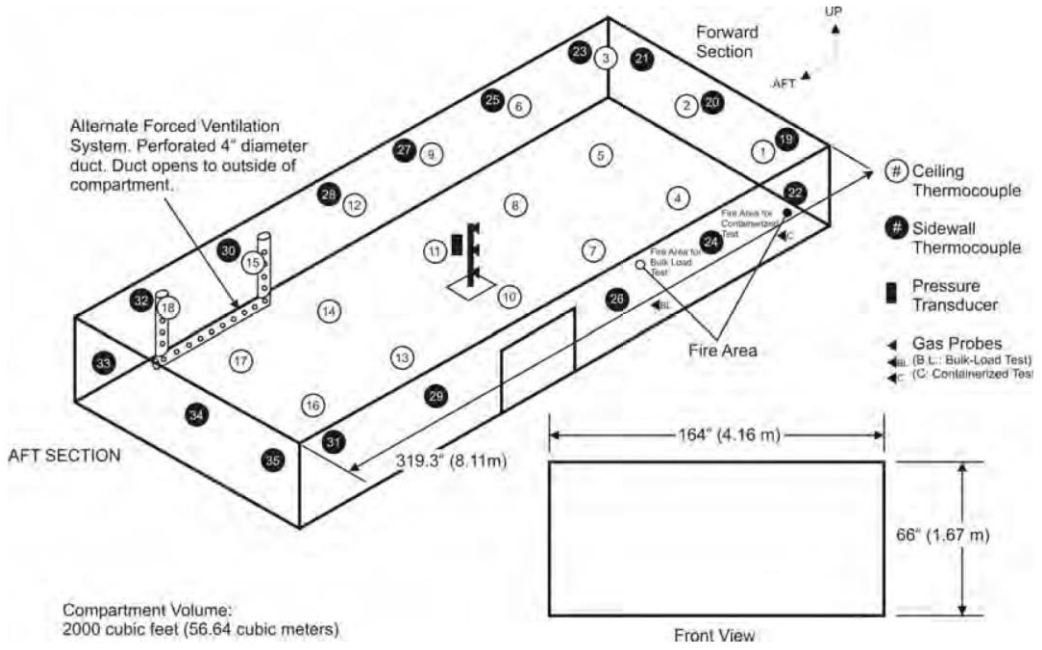
GUIDELINES GIVEN BY THE MPS

*"The fire tests are conducted inside a. The volume of the compartment is **2000 ±100 cubic feet** (56.6 ±2.8 m3) (see figure 1)."*

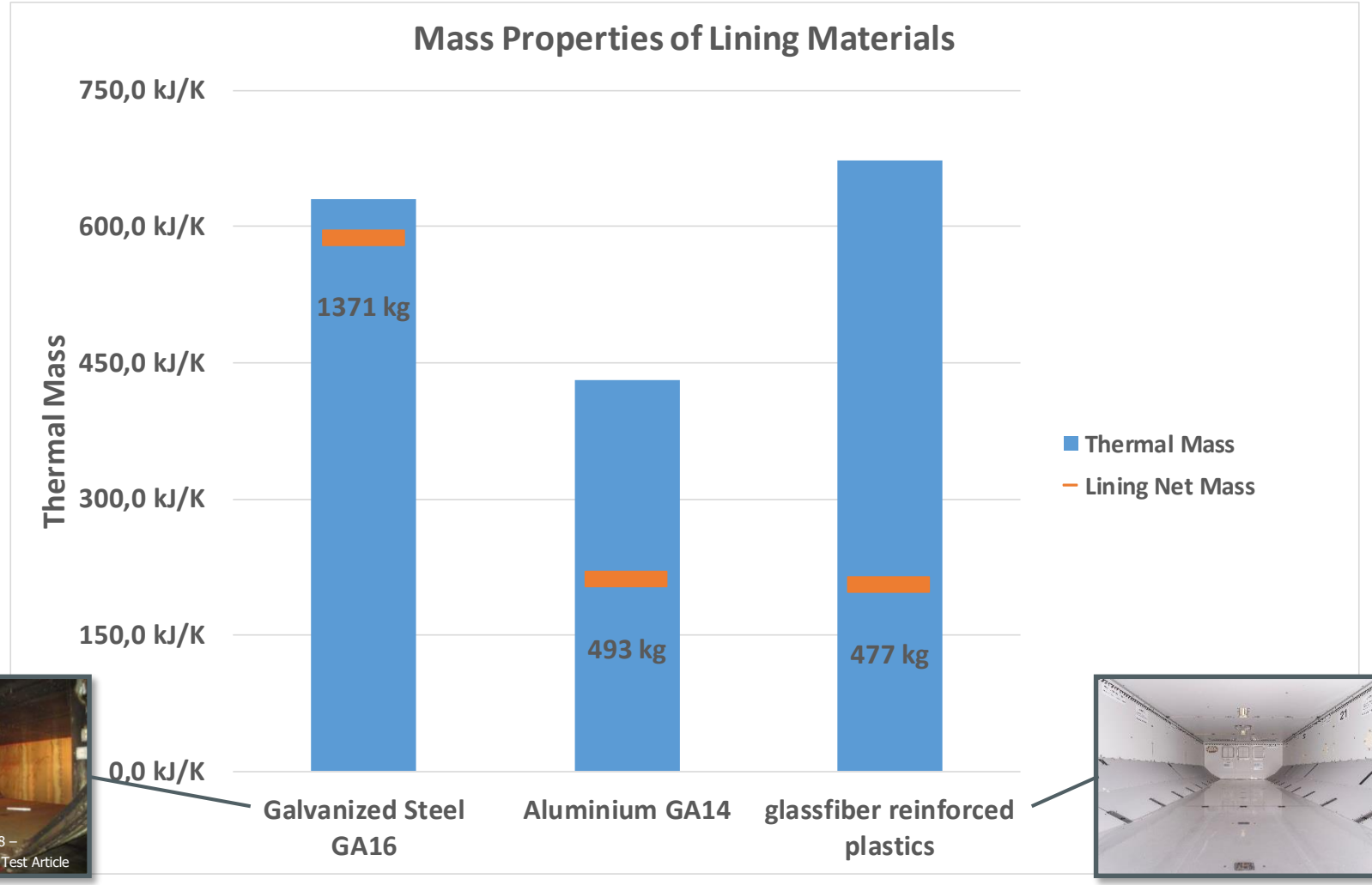


THERMAL PROPERTIES OF MPS TEST CELL LINING MATERIALS

- Lining Material for MPS Test cell is not specified
- Up to **56%** difference in thermal mass
- Thermal mass may influence MPS results

Possible effects:

- Damping of peak temperatures
- Increased thermal inertia of the test setup

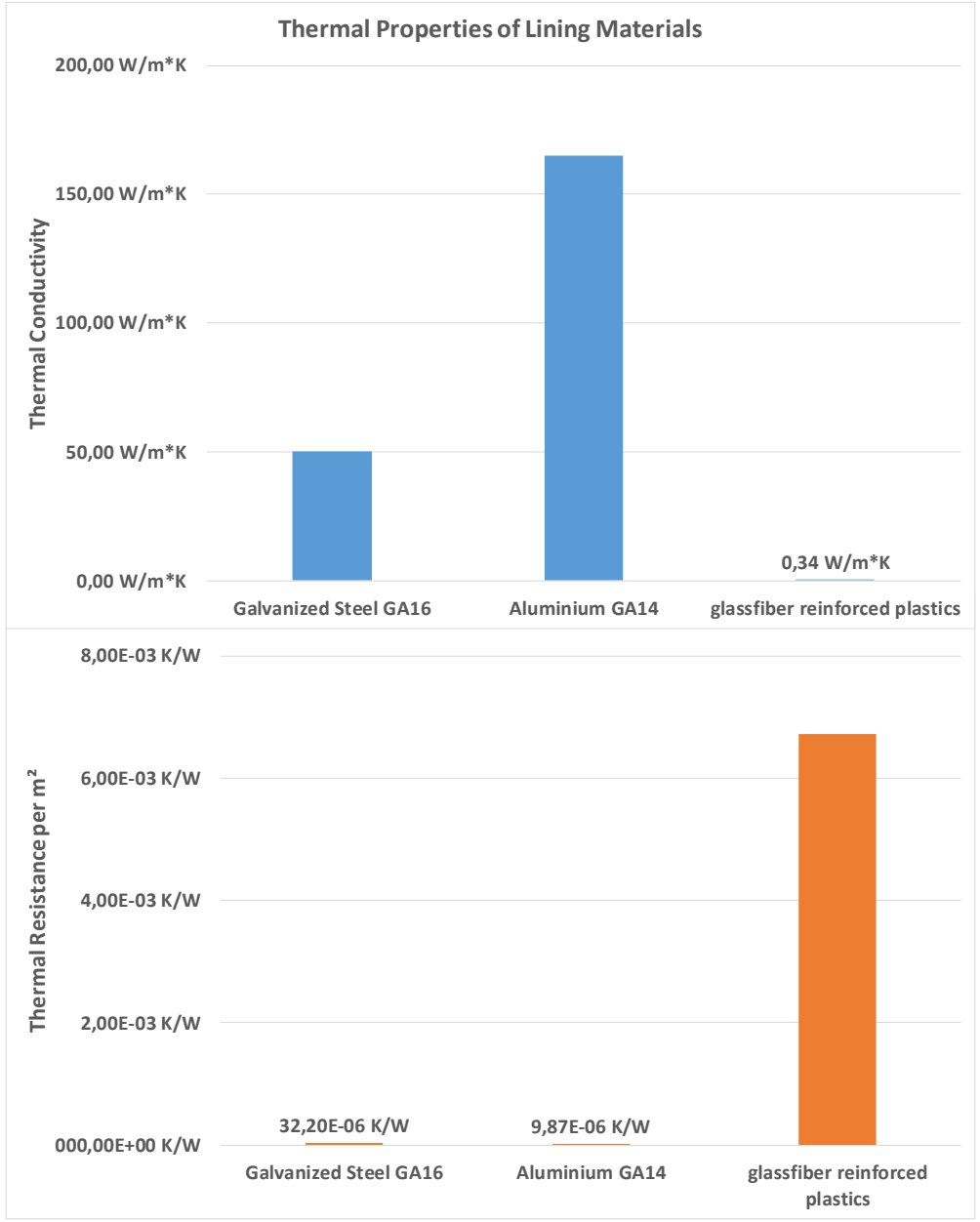


THERMAL PROPERTIES OF MPS TEST CELL LINING MATERIALS

- Lining Material for MPS Test cell is not specified
- Several orders of magnitude difference in thermal conductivity and thus thermal resistance
- Thermal conductivity and resistance may influence MPS results

Possible effects:

- Faster/slower heat conduction through lining material
- In-/decreased convective cooling at exterior of test cell (depending on outside surface- and surrounding environmental temperatures)
- Increased susceptibillity for surrounding environmental conditions (e.g. temperature, airflow, …) if test cell lining is not enclosed or insulated



SUMMARY

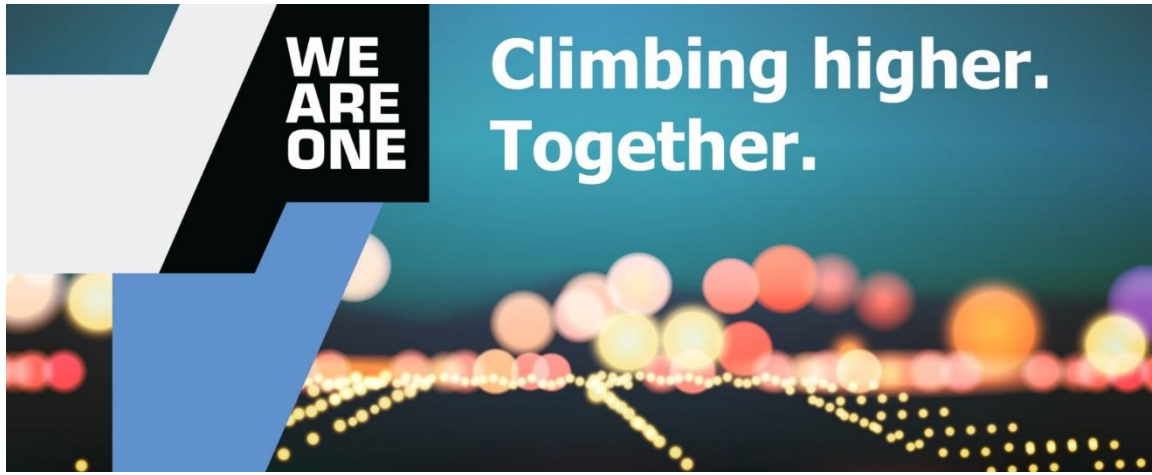
- Further investigation of macroscopic combustion behavior of common MPS fire loads is needed to better understand possible impact on MPS test results.
- A more detail definition of *„simulated, below-floor cargo compartment of a wide-body aircraft"* and *„loosely packed standard weight office paper shredded into strips"* is necessary to achieve comparable boundary conditions for different test articles.
- Cargo compartment lining material, surrounding structural buildup, insulation materials and buildup as well as shredded paper composition may need to be specified in more detail.

CONTACT

Karsten Kirbach

Research Systems
Product Innovation

Phone: +49 351 88597 -3286
karsten.kirbach@diehl.com



Diehl Aviation Holding GmbH
Vorname Nachname

Am Flugplatz
88471 Laupheim
Deutschland

Tel +49 7392 703-0
Fax +49 7392 709-1860
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