MCC Update

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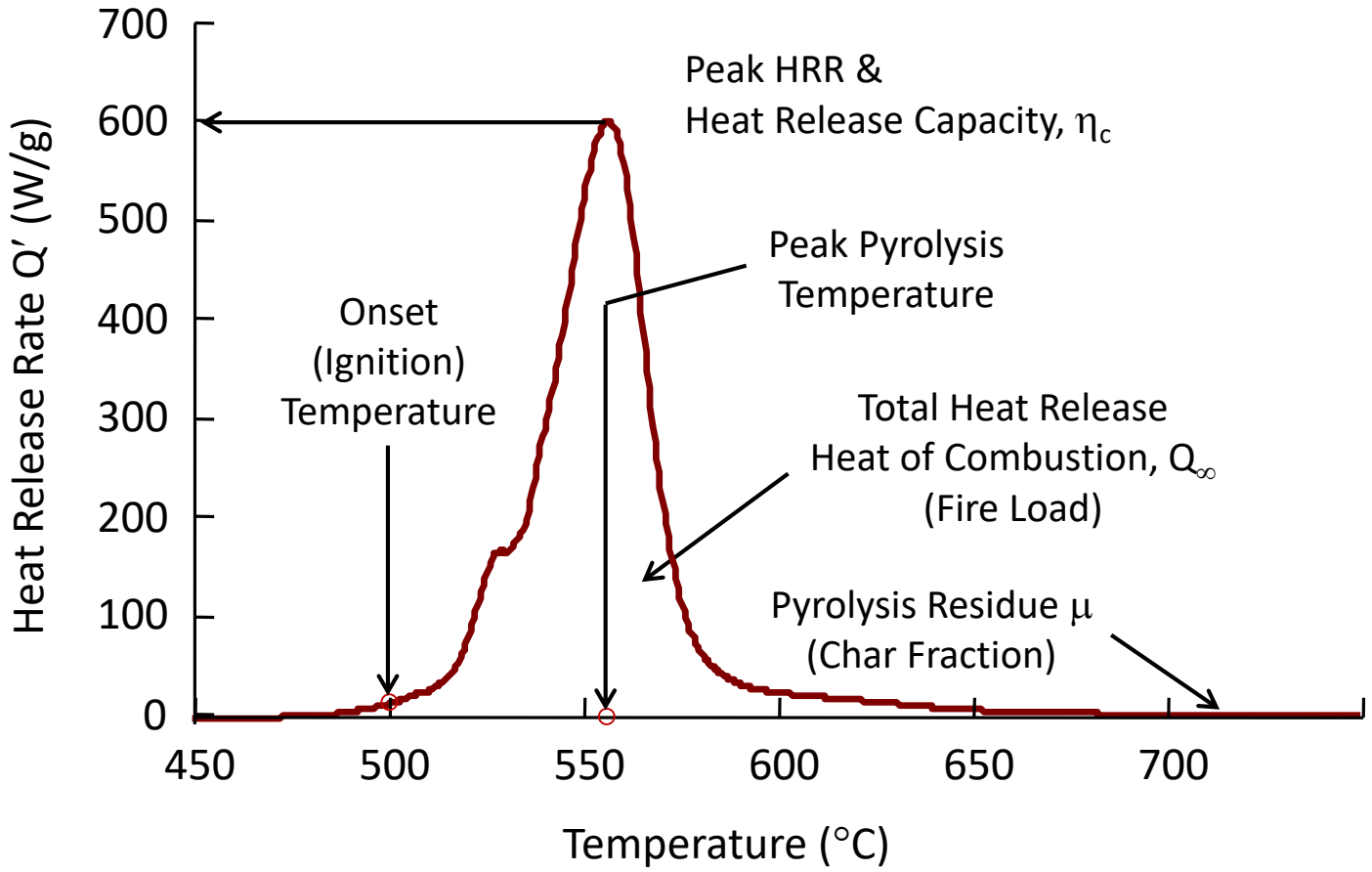
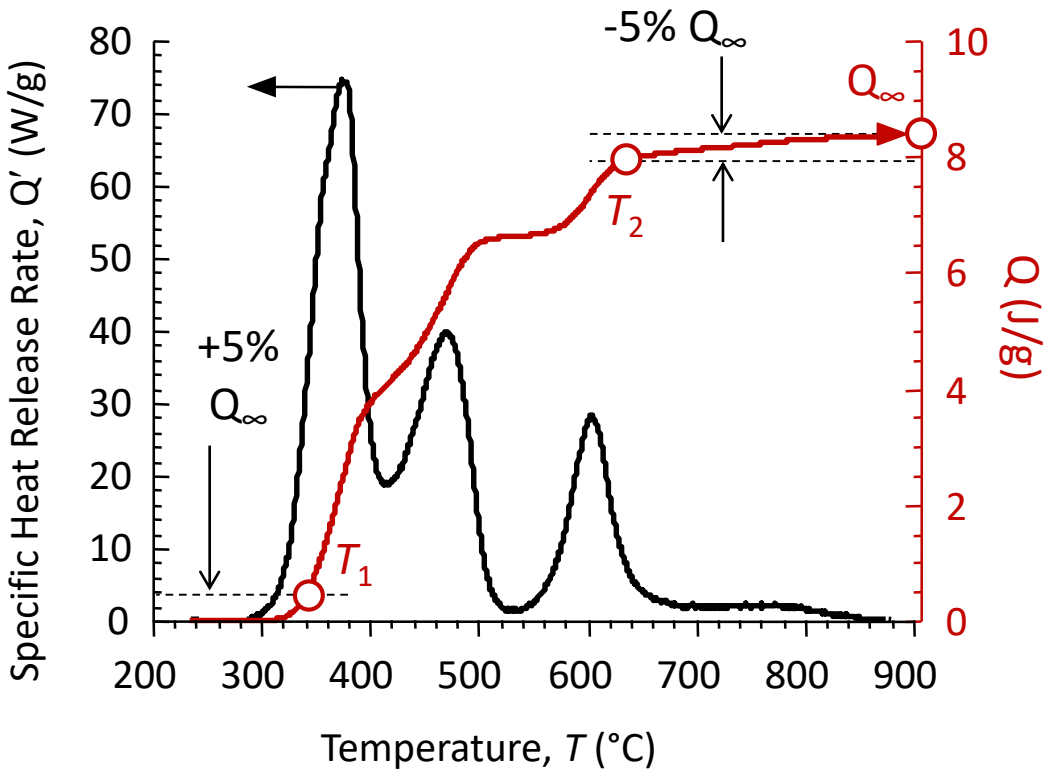
Standard Test ASTM D 7309 (Method A)

Anaerobic pyrolysis at 1 K/s + complete combustion of gases at 900°C, 20% O_2



Microscale Combustion Calorimeter

Fire Growth Capacity - FGC



T_0 = 25°C (298K)

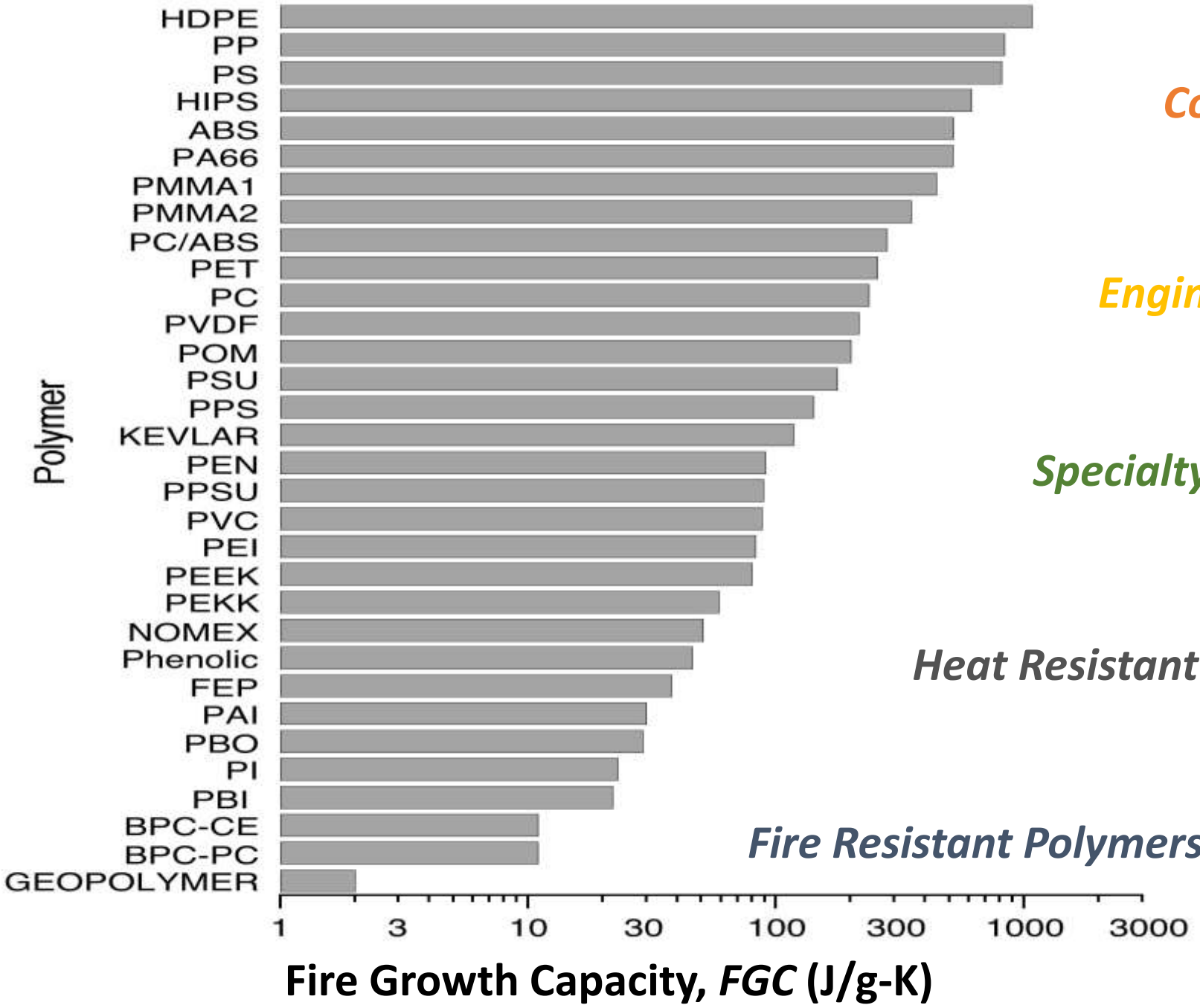
T_1 = Ignition temperature

T_2 = Burning temperature

$$FGC = \left(\frac{Q_\infty}{T_2 - T_1}\right)\left(\frac{T_2 - T_0}{T_1 - T_0}\right)$$

MCC procedure for FGC

1. Measure specific heat release rate Q′ versus temperature *T* as per ASTM D7309 (5 replicates)
2. Integrate Q′/β versus *T* to obtain Q versus *T*, i.e., Q(*T*)
3. Obtain total heat release $Q(T_\infty) = Q_\infty = h_c$(J/g)
4. Obtain T_1 at 5% deflection from Q(T) baseline, i.e., at $0.05Q_\infty$
5. Obtain T_2 at Q_∞ i.e., $0.95Q_\infty$.
6. Calculate Fire Growth capacity (FGC)



Commodity Plastics

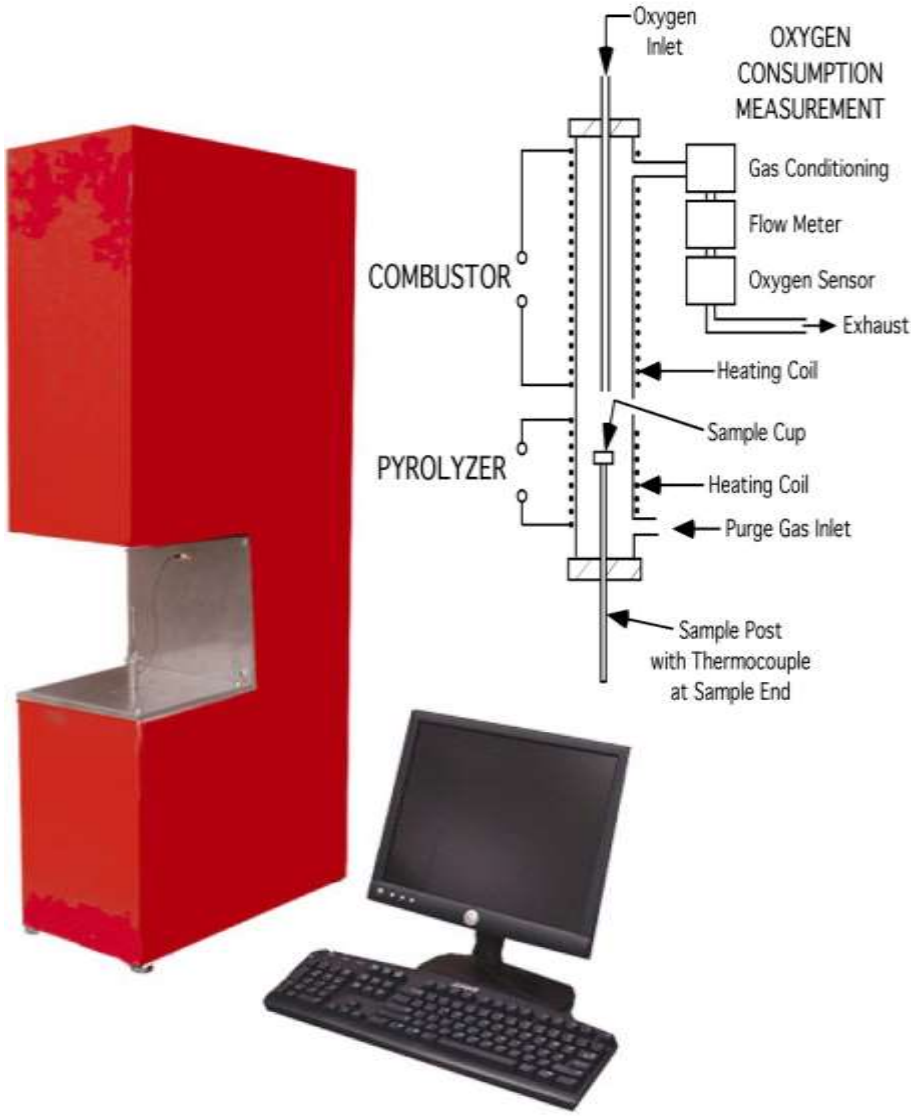
Engineering Plastics

Specialty Plastics

Heat Resistant Plastics

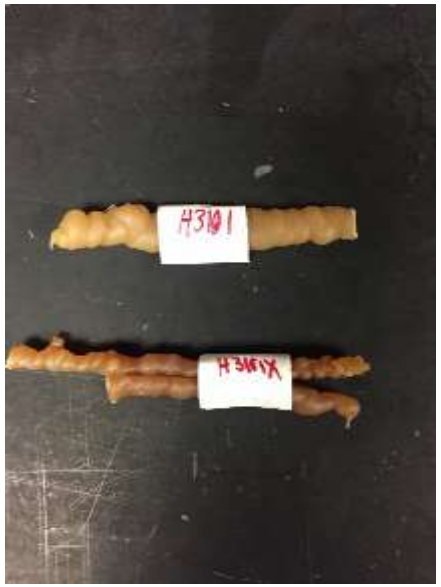
Fire Resistant Polymers

FAA Microscale Combustion Calorimeter (ASTM D7309)



- Fire Growth Capacity ***FGC*** is a measure of ignitability and burning rate of the material, i.e., the **total fire hazard**
- *MCC* is proposed method for **alternate means of compliance** when a small change is made to a construction
- ASTM Ballot on new baseline averaging method
- ASTM FAA MCC ILS

Similarity Project Background



- **Small changes** in the composition of certified aircraft cabin materials are often needed due to unavailability of the original components or environmental regulations
- Recertification of the entire constructions are costly
- Aircraft manufacturers and suppliers asked the FAA to explore alternative means of complying with the FAR in 2015.
- The Material Similarity Task Group was created to develop a method and criterion for comparing flammability of samples at micro-scale using ASTM D7309 (MCC).

Similarity Criterion

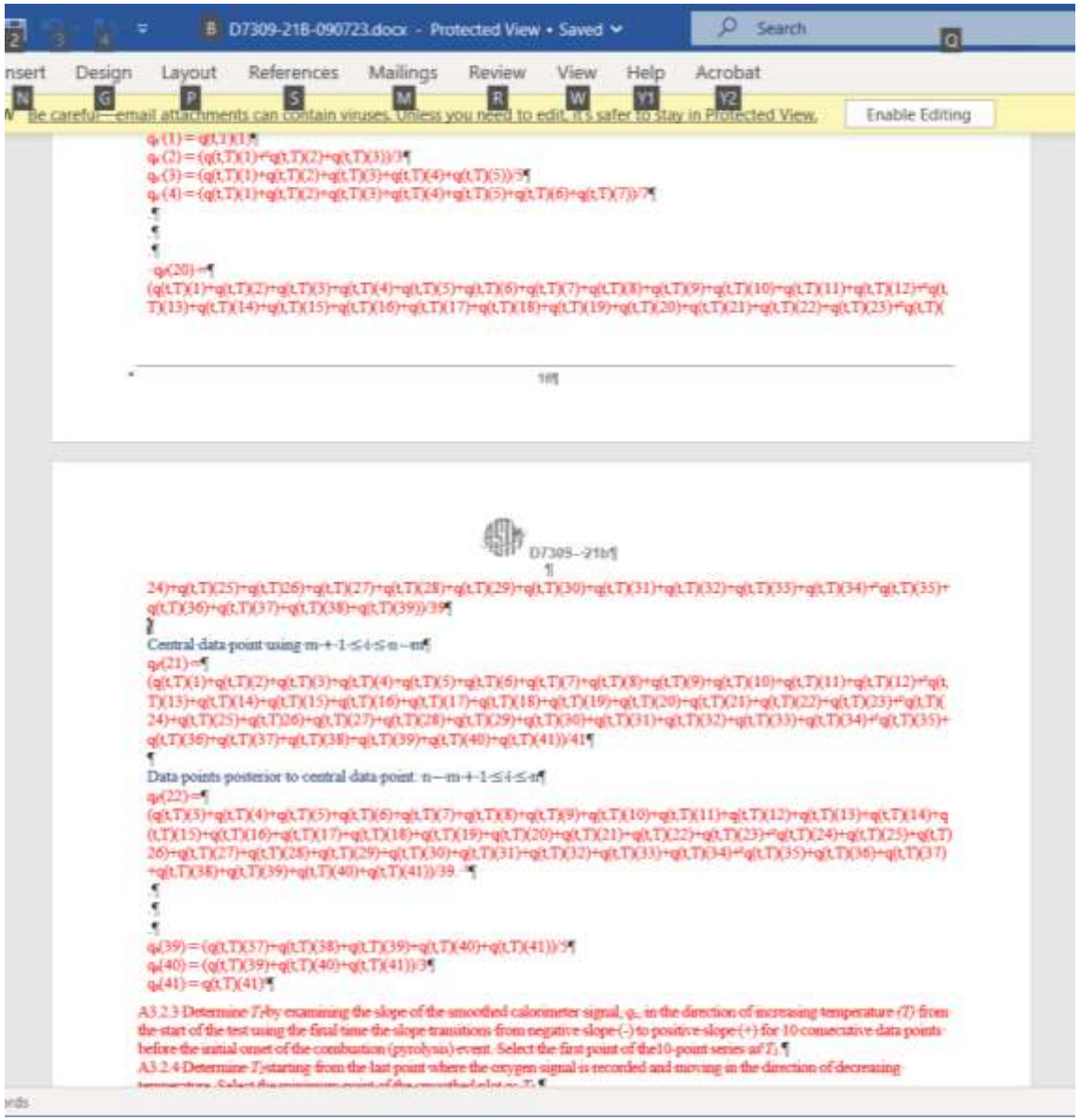
$$\frac{\Delta FGC}{FGC_B} \leq 0.3$$

The no-effect level of a material change at micro-scale is equal to the relative uncertainty of bench-scale FAR fire test results at the 95% confidence level, i.e., 30%, as determined by testing.

Next steps:

- Jeff Gardlin's presentation on Transport Airplane Issue List (TAIL).
- ASTM D7309-21 inter-laboratory study to-
  - Determine repeatability and reproducibility of FGC
  - Include ultra-low heat release aircraft phenolic resin.

ASTM D7309 Standard Revision



NEGATIVE

- Specified data window is wrong
  - Temperature Based
- Replace pages of changes with a single reference
- Endpoint Selection
  - Variation in Temp (X-axis) doesn't affect results much
  - Should be more concerned with HRR datapoint (Y-axis)
  - Artificially High or Low point

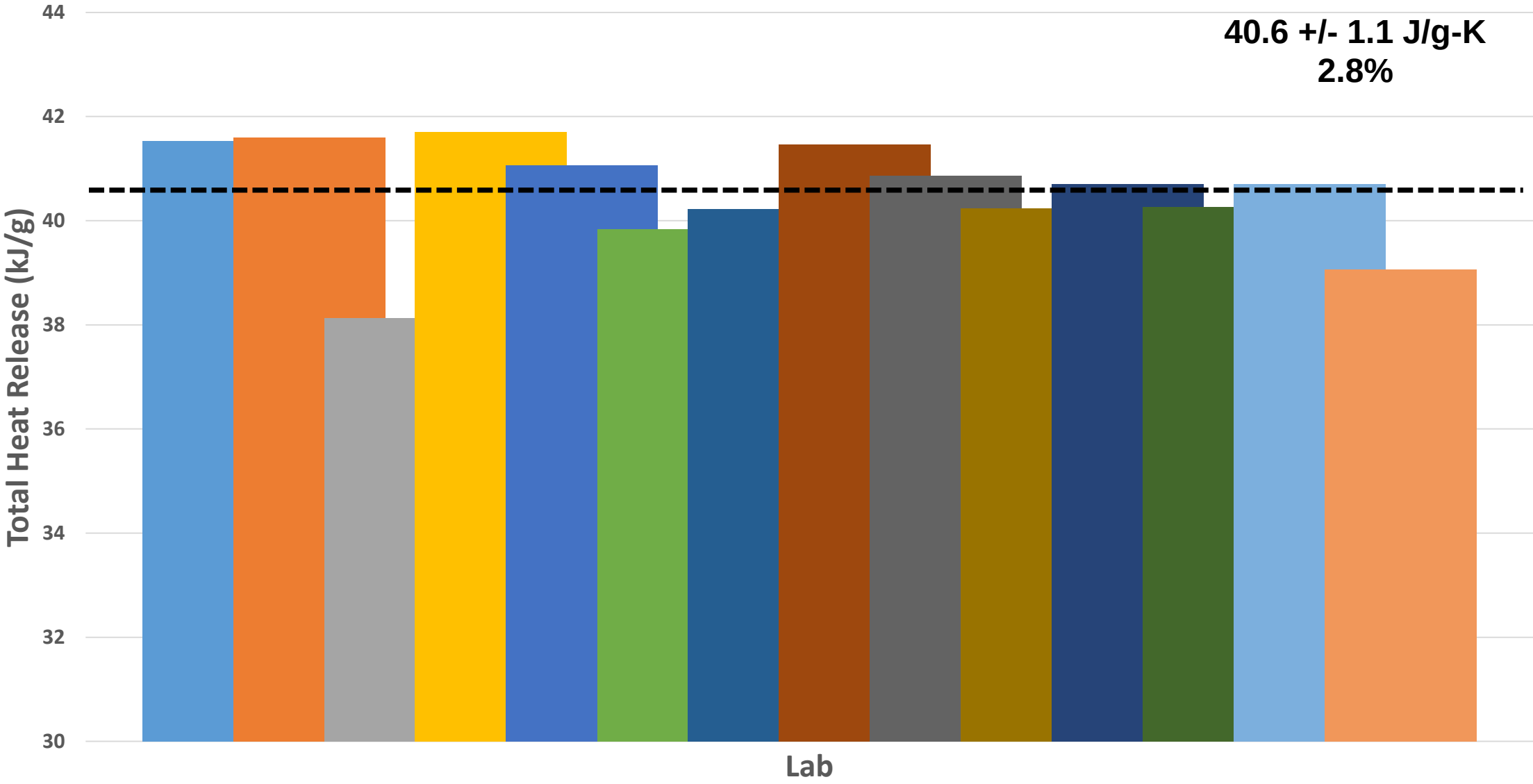
Preliminary Inter-Laboratory Study

- **4 manufacturers/licensees of the MCC**
  - **Deatak**
  - **Fire Testing Technologies**
  - **Concept Equipment Ltd**
  - **Me**

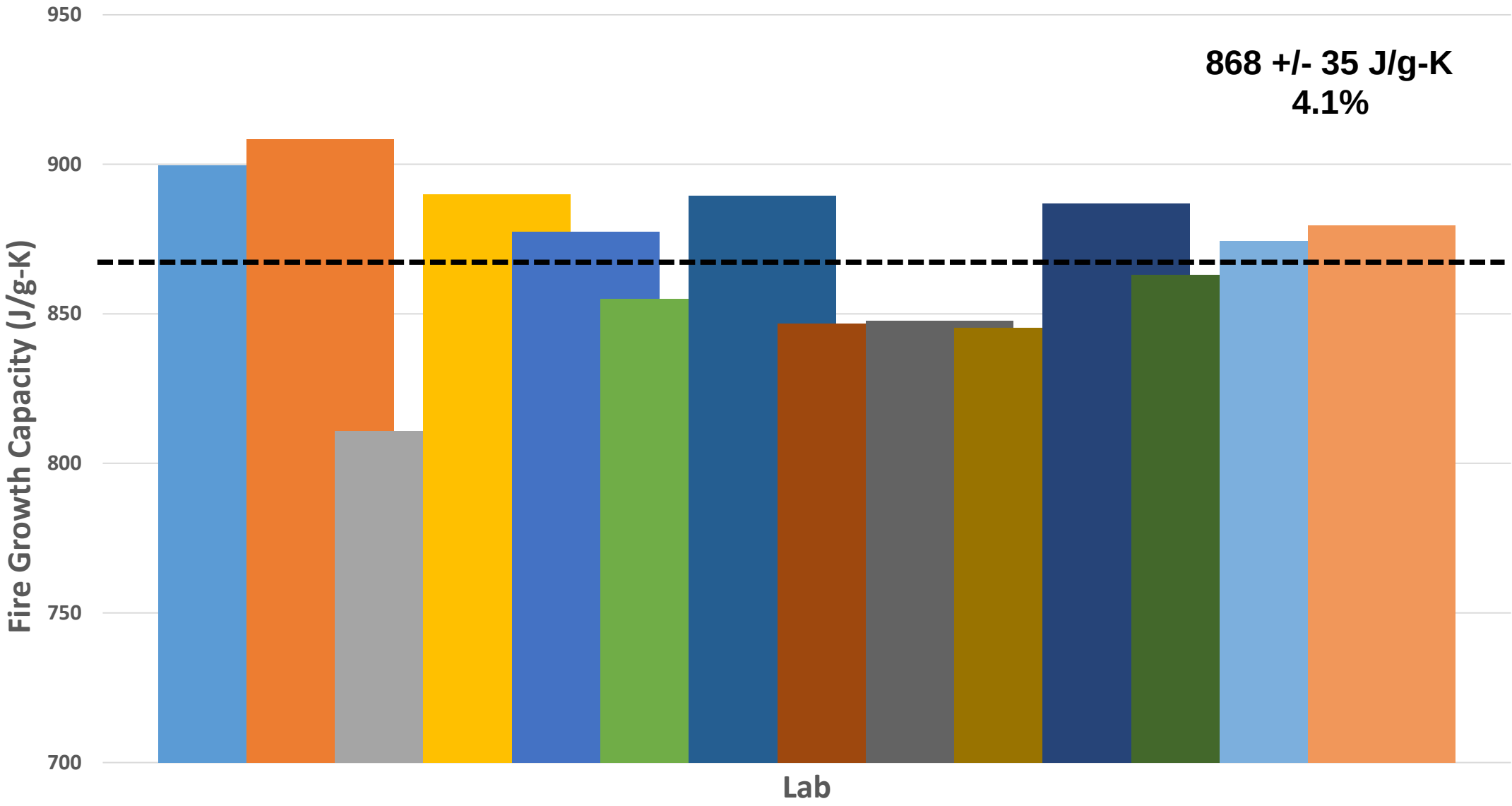
- **Samples sent to labs**
  - **14 labs were able to participate**
  - **Several labs could not participate due to equipment not working**

- **Data received from 14 labs**
  - **Several labs need equipment adjusted**
  - **Several labs equipment was fine but data was re-analyzed and interpreted by me**

Lab Comparison – Total Heat Release



Lab Comparison – Fire Growth Capacity

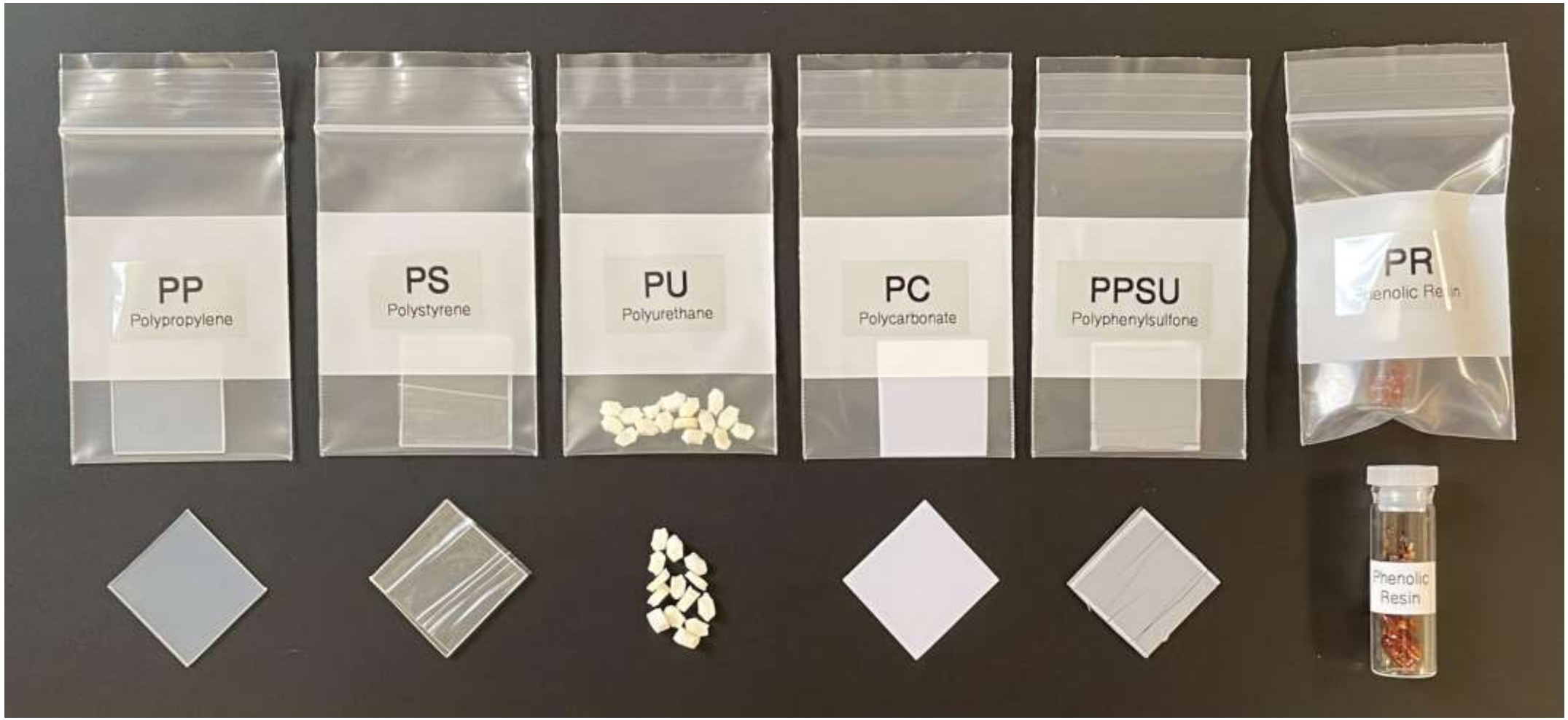


ASTM E691

Conducting an Inter-Laboratory Study to Determine the Precision of a Method

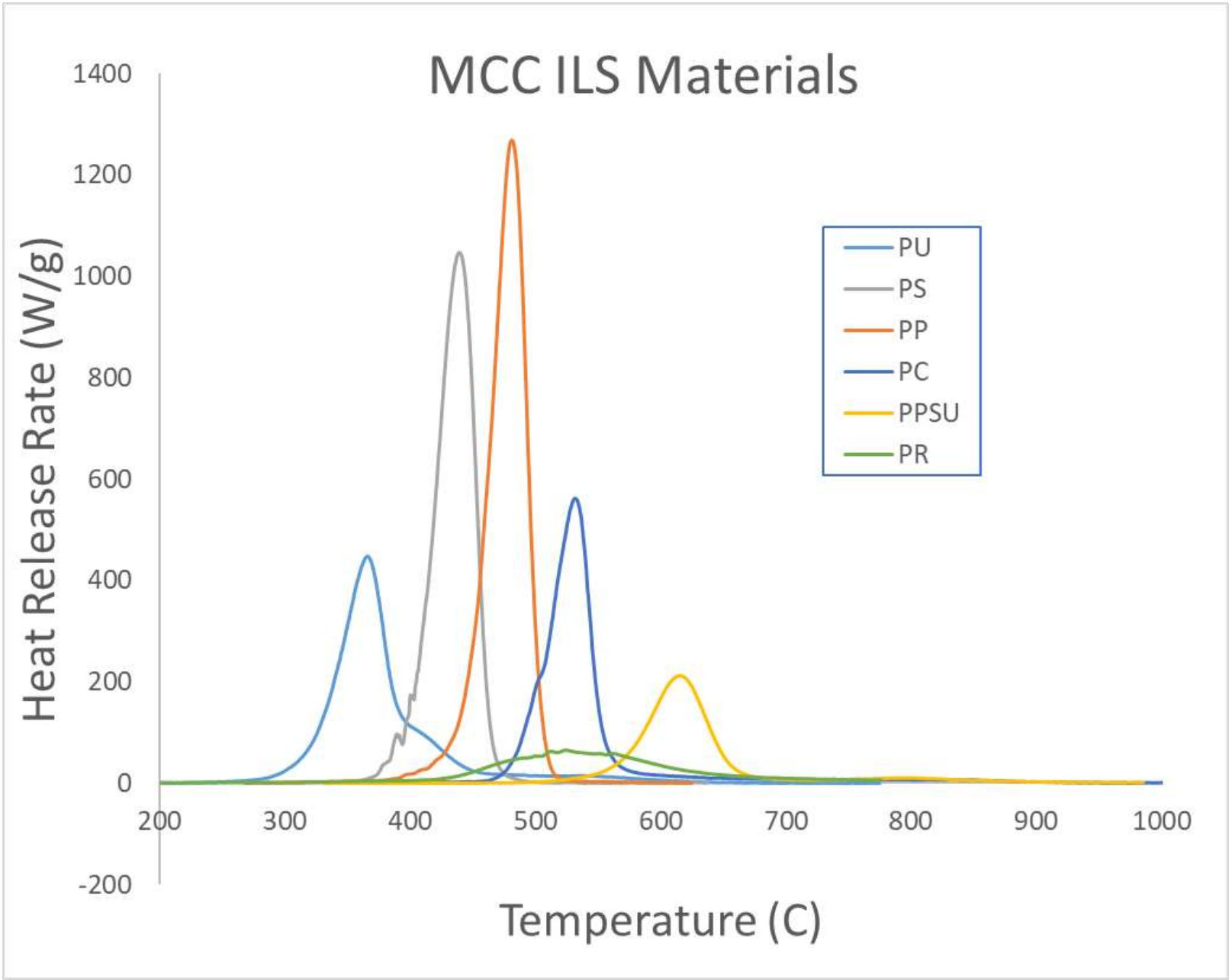
- **Repeatability**
  - **An action, event, or other thing that is done again**
- **Reproducibility**
  - **Create something very similar to (something else) in a different medium or context**

Samples for ASTM FAA MCC ILS



Aircraft Material - Boeing Phenolic Resin

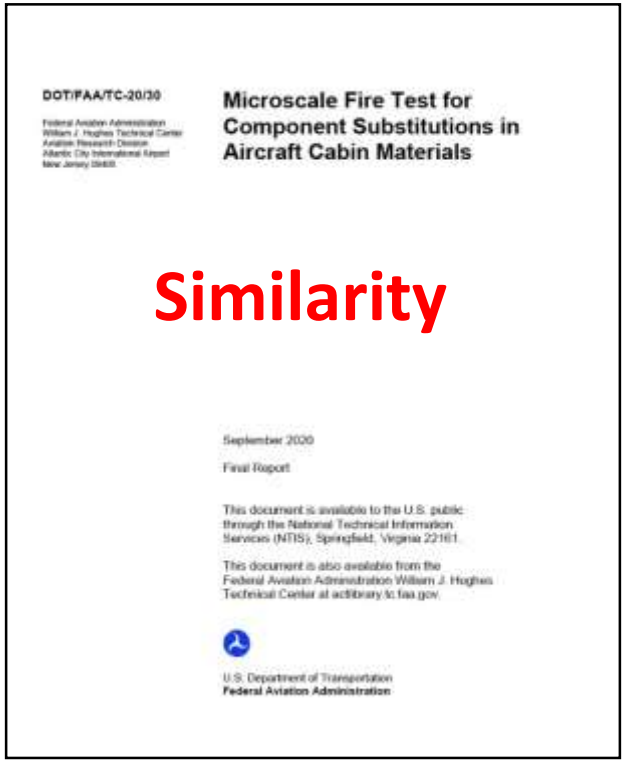
MCC Heat Release Rate – ILS Materials



Summary & Future Work

- **Inter-laboratory study – Round 2 (ASTM)**
  - **Input values into ASTM ILS website**
  - **Send set of 6 samples to labs**
  - **Results submitted directly to ASTM**
  - **Updated Precision & Bias statement**
  - **FAA report**
- **ASTM Standard Revision**
  - **Negative**
- **MCC for Alternate Means of Compliance**

FAA Reports - https://www.fire.tc.faa.gov/


DOT/FAA/TC-20/30

Microscale Fire Test for Component Substitutions in Aircraft Cabin Materials

Similarity

September 2020

Final Report

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

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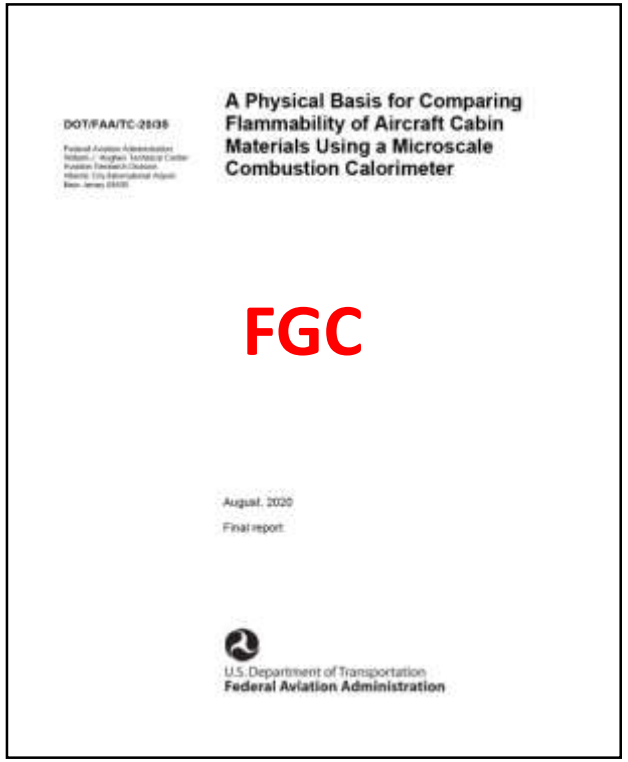
U.S. Department of Transportation
Federal Aviation Administration


DOT/FAA/TC-20/35

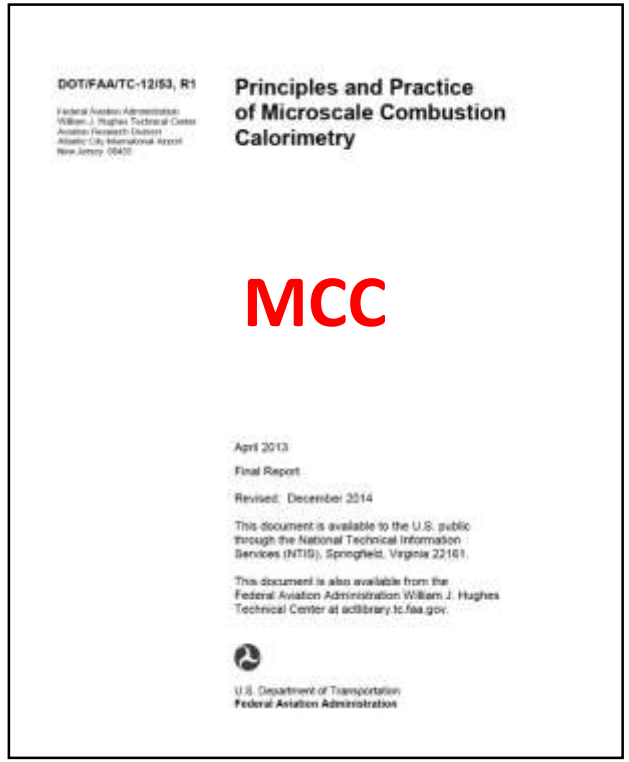
A Physical Basis for Comparing Flammability of Aircraft Cabin Materials Using a Microscale Combustion Calorimeter

FGC

August, 2020

Final report

U.S. Department of Transportation
Federal Aviation Administration


DOT/FAA/TC-12/53, R1

Principles and Practice of Microscale Combustion Calorimetry

MCC

April 2013

Final Report

Revised: December 2014

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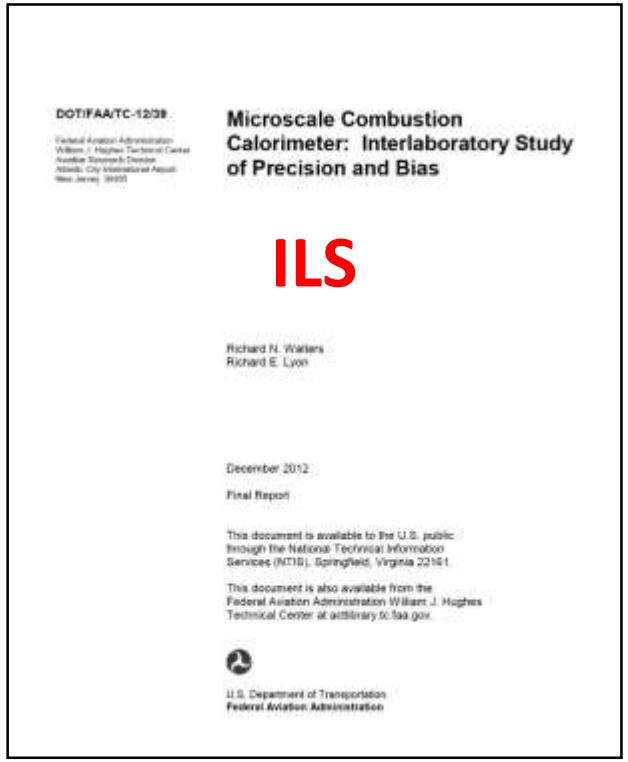
DOT/FAA/TC-12/39

Microscale Combustion Calorimeter: Interlaboratory Study of Precision and Bias

ILS

Richard N. Walters
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December 2012

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