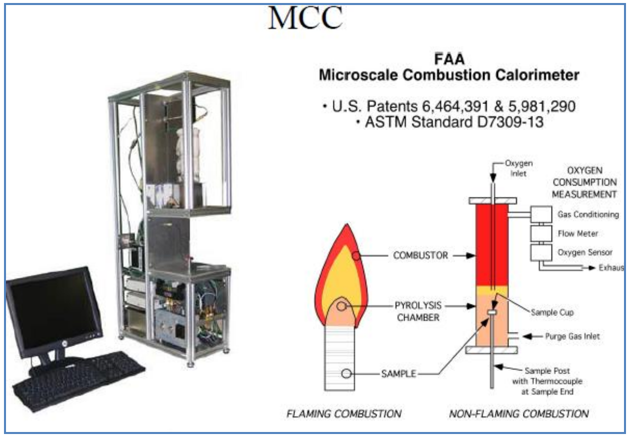
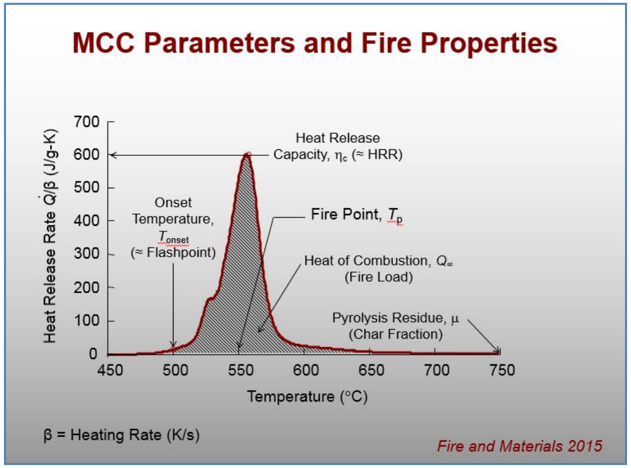
Material Change Similarity Task Group Status

AC Guidance Proposal Using the Microscale Combustion Calorimeter

Materials Fire Test Working Group
June 7-8, 2016



Rich Lyon, FAA Tech Ctr
Dan Slaton, Boeing



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Presentation Outline:

- Background
- Process Flow Chart
- Proposed approach for new AC
- Next Steps

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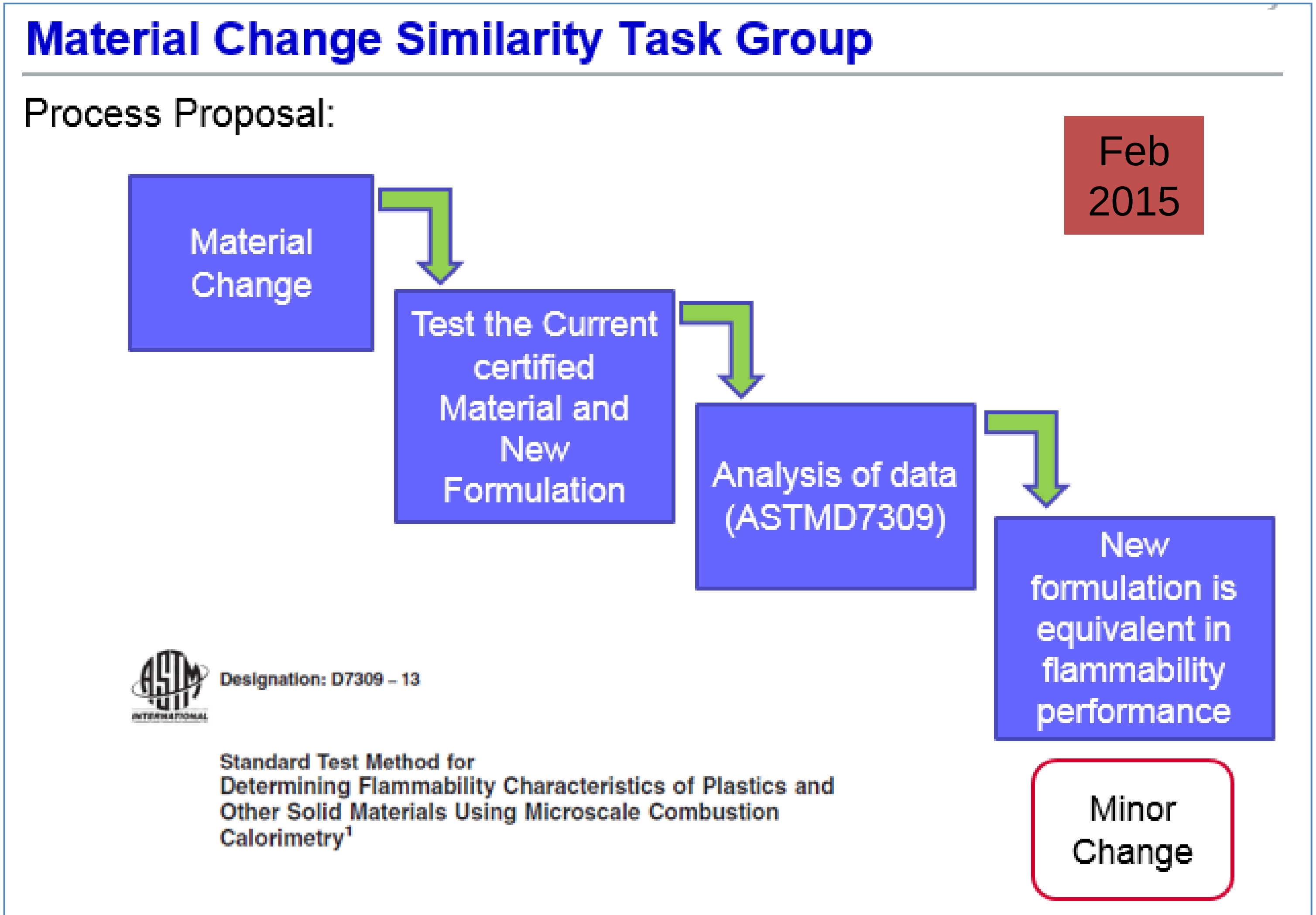

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Draft Advisory Circular

ADVISORY CIRCULAR

(Author Note: AC25.856-1a was used as a template.)

Subject: MICROSCALE COMBUSTION CALORIMETRY TEST METHOD FOR DETERMINING WHETHER A MATERIAL CHANGE CAN BE CLASSIFIED AS A MINOR CHANGE FOR FLAMMABILITY

1. PURPOSE. This advisory circular (AC) provides guidance on using the Microscale Combustion Calorimetry (MCC) test method to determine the relative flammability performance characteristics of a material. This method can be used to compare the flammability properties of a currently certified material with those of the material that has been changed in some way (e.g. chemical/material changes to remove environmental impacts, alternate sources of chemical constituent/material, replacement for out-of-production material, changed material to improve manufacturing & performance properties, etc…) to determine if there is a significant change in the fundamental flammability properties. Once determined to have similar flammability properties at the material level, this data supports a minor determination of the material change, thus eliminating the need to assess the specific flammability properties of all the different part configurations where this material is used.

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c. Components of aircraft interior materials that can be considered for a minor change determination by MCC testing are those whose properties can be adequately represented by a 5-10 milligram sample. Examples of these include adhesives, potting compounds, coatings, films, plastics, resins, rubber, textile fibers used in different design configurations. At the present time it is common practice to fabricate flammability test samples of all the different design configurations using the new/modified material or new component and perform a full complement of FAA flammability tests (Bunsen burner, OSU heat release, Smoke Optical density, Flame Propagation, etc…) for the different configurations using the material. This approach of fabricating and testing large numbers of test configurations is very expensive. The MCC offers a standard method and procedure to compare the fire properties of a new component with those of an existing component in a certified configuration. If the fire properties of the new component are similar to the original component, and the fabricated part containing this new component is otherwise unchanged, it is expected that the flammability properties of the changed part will be equivalent to the certified part, and that the substitution of the new component for the original component is a small (minor) change - eliminating the need to perform extensive configuration tests.

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5. DEFINITIONS.

a. A <u>component</u> is any substance used in the construction of an aircraft cabin material whose fire properties are adequately represented by the 5-10 mg sample used in ASTM D7309. Examples of suitable components are adhesives, potting compounds, coatings, films, paints, plastics, resins, elastomers, rubber, fibers, wire jackets, etc..

b. <u>Similar</u> is understood to mean that the MCC fire properties that scale with flammability, heat release capacity (HRC) and total heat release (HR) of a new component are less than or equal to the original component to within the reproducibility limits set forth in ASTM D 7309.

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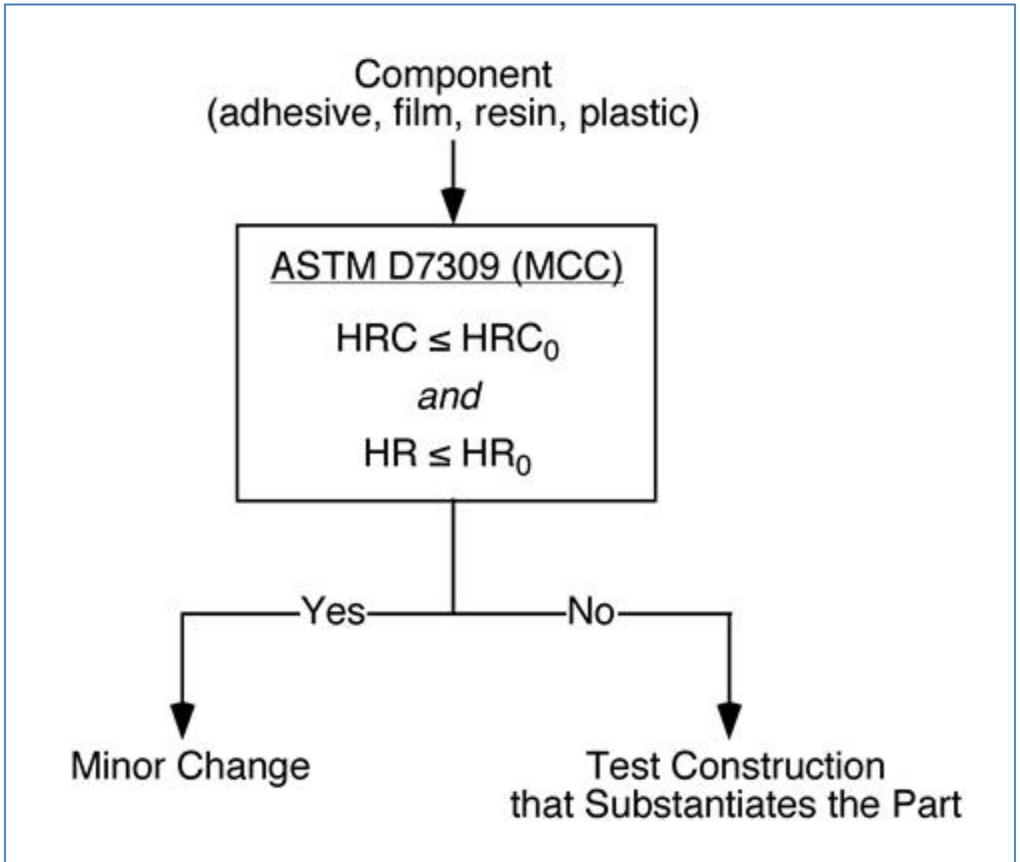

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Next Steps:

1) Review draft AC, provide inputs
2) Industry to identify certain data available to validate the process
3) Final draft AC to FAA – October 2016
4) FAA to propose new AC 2017 (concurrent with NPRM)

Backup charts

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Background:

March 2014:

- Dick Hill presented "FAA Initiaties in Flame Retardant Replacements."
  - Develop approach to evaluate flame retardant replacements and define similarity.
  - http://www.fire.tc.faa.gov/pdf/materials/March14Meeting/Lyon-0314-Similarity.pdf

June 2014:

- Dan Slaton presented outline of possible approaches for Task Group.
  - Proposed approach to establish "minor change."
  - Defined initial scale that demonstrates similarity / equivalency.
  - http://www.fire.tc.faa.gov/ppt/materials/June14Meeting/Boeing-0614-MaterialChangeSimilarityTG.ppt

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Background (cont):

October 2014:

- Rich Lyon presented background of MCC activities and similarity approaches.
- http://www.fire.tc.faa.gov/pdf/materials/Oct14Meeting/LYON-1014-FlameRetardants.pdf

Similarity

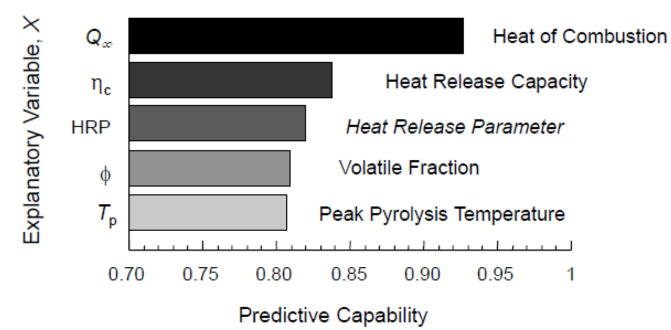
A certified Configuration A is *changed* to Configuration B.

From a certification standpoint, these configurations will be equivalent with regard to safety (similar) if the certification data that substantiates Configuration A also substantiates Configuration B.

In other words A and B are similar if the changes to A, whatever they are, do not impact the original basis for certification.

Flame Retardants & Material Change Similarity
IAMFTWG Meeting, Atlantic City, October 27, 2014
Federal Aviation Administration
5

Predictive Capability of ASTM D 7309 Material Properties in Pass / Fail Fire Tests



Flame Retardants & Material Change Similarity
IAMFTWG Meeting, Atlantic City, October 27, 2014
Federal Aviation Administration
12

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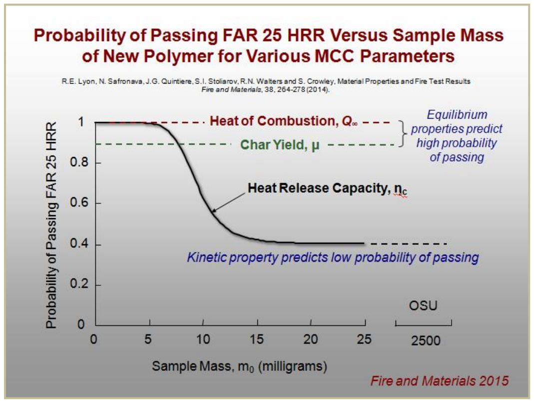
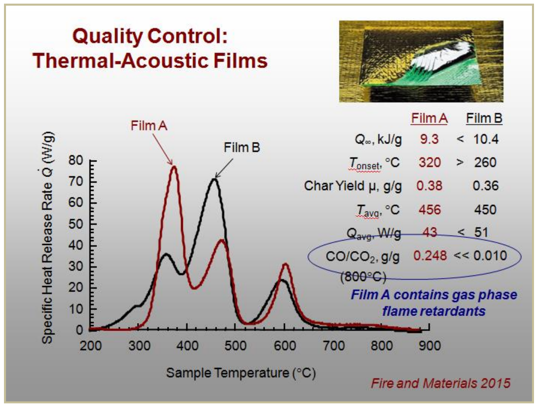
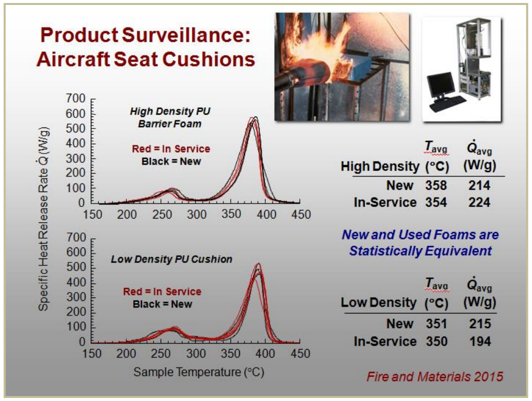
Background (cont):

- February 2015 – INTERFLAM – Materials and Fire Conference
  - Rich Lyon presented "Practical Aspects of MCC."
  - MCC probability of passing FAR 25 HRR based on sample Mass.
  - Proposed using MCC for quality control and product surveillance.







- February 2015 – FAA Fire Test Working Group
  - Proposed "minor change" process
  - https://www.fire.tc.faa.gov/pdf/materials/Feb15Meeting/Slaton-0215-MaterialChangeSim.pdf

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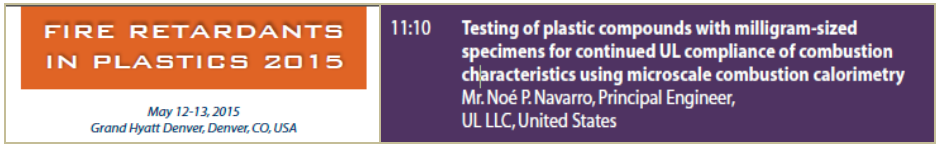
Background (cont):

- May 2015
  - UL Fire Retardants in Plastics Conference



- October 2015 – FAA Fire Test Working Group
  - UL Presentation – Assessing Material Consistency Using MCC
  - https://www.fire.tc.faa.gov/pdf/materials/Oct15Meeting/Fabian-1015-MCC.pdf

- June 2016 – FAA Fire Test Working Group
  - Rich Lyon presented case studies comparing MCC to FAR Flam Test results
  - https://www.fire.tc.faa.gov/pdf/materials/June15Meeting/lyon-0615-MCCSimilarity.pdf

Material Change Similarity

ASTM D7309 – Reproducibility Limit

D7309 – 13

TABLE 2 Peak Heat Release Rate (W per g)

Material	Average[A]	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit	Reproducibility Limit
	$\bar{x}$	s_r	s_R	r	R
Acrylic	468.6	8.3	28.9	23.3	80.9
PP	1083.6	22.8	89.3	64.0	250.1
HIPS	714.9	23.4	64.7	65.6	181.1
PC	526.9	25.0	54.1	70.0	151.4
PPSU	205.2	6.6	19.0	18.5	53.3

[A]The average of the laboratories' calculated averages.

TABLE 3 Heat Release Capacity (J per g-K)

Material	Average[A]	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit	Reproducibility Limit
	$\bar{x}$	s_r	s_R	r	R
Acrylic	471.0	9.0	26.7	25.1	74.7
PP	1095.3	32.5	86.4	91.0	242.0
HIPS	715.0	23.0	59.1	64.5	165.5
PC	529.5	25.3	48.2	70.9	134.9
PPSU	208.8	7.4	18.0	20.8	50.5

[A]The average of the laboratories' calculated averages.

Material Change Similarity

ASTM D7309 – Reproducibility Limit

D7309 – 13

TABLE 4 Total Heat Release (kJ per g)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Acrylic	23.5	0.2	1.4	0.6	3.8
PP	41.5	0.8	2.3	2.3	6.4
HIPS	34.2	0.3	1.7	0.9	4.7
PC	21.0	0.3	1.3	0.8	3.6
PPSU	11.9	0.3	1.0	0.7	2.8

[A]The average of the laboratories' calculated averages.

TABLE 5 Peak Heat Release Temperature (°C)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Acrylic	390.4	2.1	8.2	5.9	23.0
PP	481.1	2.0	9.8	5.7	27.5
HIPS	456.0	2.2	8.4	6.1	23.6
PC	525.3	2.4	11.4	6.6	31.8
PPSU	606.6	1.8	15.1	5.1	42.3

[A]The average of the laboratories' calculated averages.

TABLE 6 Char Yield (%)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Acrylic	0.18	0.23	0.32	0.64	0.91
PP	0.21	0.19	0.34	0.53	0.96
HIPS	8.22	0.90	1.24	2.53	3.46
PC	19.38	0.91	1.62	2.54	4.52
PPSU	41.25	1.36	2.54	3.80	7.12

[A]The average of the laboratories' calculated averages.