2017 NBS Smoke Density Round Robin

October Materials Meeting
Atlantic City, NJ

Materials Working Group

Michael Burns, FAA Tech Center

October, 2017

Federal Aviation Administration

AGENDA (NBS)

- Participating Labs (39 labs / 44 Units)
- Test plan
- Timelines
- Compiled Test Data
- Conclusion / Analysis

NBS RR – Participating Labs

ACES, Inc	Herb Curry (2)
Aeroplast Factory - EgyptAir	ISOVOLTA AG
Aeroworks Composites B.V.	ISOVOLTA America
AIM Aerospace, Inc.	Jamco - America
AIM Altitude	Jamco - Singapore
Airbus Deutschland GmbH (2)	JEHIER SAS
Boeing Company (SC)	Krueger Consulting LLC
Boeing Company (Seattle)	Lantal
C&D Zodiac Aerospace, Huntington Beach (2)	LEFAE
C&D Zodiac Aerospace, Marysville	RESCOLL Technical Centre of Materials
CREPIM	Rockwell Collins (formerly BE Aerospace)
CTA	Rockwell Collins AZ
DGA Aeronautical Systems	SEKISUI SPI
Diehl Aircabin GmbH	SELL (Zodiac Premium Galleys)
DLR (2)	Skandia
Element Materials Technology Los Angeles	Test Center of CAAC (TCCAAC)
F. LIST GMBH	Testcorp (2)
FAA Technical Center	TTF Aerospace
Govmark, LLC	Zodiac Seat Shells
HAECO Americas Cabin Solutions	

NBS RR – Test Plan

Purpose

- Compare data between several NBS Smoke Density Chambers Industry wide.
- Research includes measuring specific optical density and off-gassing toxicity levels of test coupons.
- Calibration and material testing conducted as per Chapter 6 of the FAA Fire Test Handbook.

POC
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The FAA Tech Center will provide all test materials and instruction necessary for the completion of this round robin. The round robin is divided into two parts (Part I and Part II).

Part I	Specific Optical Density Testing
Part II	Toxicity Data Collection (optional)

NBS RR – Test Plan

Materials To Be Tested

Figure #1 – Foam Material (White)

- Test Either Side

(Zotefoams)

Figure #2 – Schneller Test Panel

- Test Gray Lettering Side

(Schneller, Inc.)

NBS RR – Test Plan

Smoke Density Testing

- Calibration and material testing will be conducted as per Chapter 6 of the FAA Fire Test Handbook (https://www.fire.tc.faa.gov/pdf/handbook/00-12_ch6-0217.pdf).
- A set of foam coupons and Schneller test coupons used for this round robin.
- All test samples are of the same lot (no specific orientation required for either material).
- Tests conducted once all calibration procedures have been completed.
- The lower pilot burner tube must be in place when verifying heat flux levels.
- All coupons conditioned for a minimum of 24 hours at 70° ± 5°F (21° ± 3°C) and 50% ± 5% relative humidity before being tested.
- Test all five (5) coupons (only uncorrected smoke density values are to be reported).

NBS RR – Test Plan

Toxicity Testing (optional)

- Toxicity testing was optional for participation in this round robin.
- If providing toxicity data, perform testing using Draegar tubes and only for a maximum of 3 specimens per material (unless you would like to test all 5).
- Report toxicity values in the data sheet provided in the appendix.
- If facility would like to conduct wet analysis testing, that data will be shared with the group as well.

NBS RR – Timeline

- It was requested that all labs verify the feasibility of participating in the round robin and reply back to the Tech Center no later than Monday August 14, 2017.
- A mailing list was generated for shipping out two sets of five test coupons each to all participating labs.
- Labs were assigned unique identification codes to share compiled test results.
- Once a lab received the test material, all test coupons were removed from packaging and placed in a conditioned environment as per Chapter 6 of the FAA Fire Test Handbook.
- Completion deadline of 10/20/2017

NBS RR – Appendix Data Sheet

General Information		
Lab Name		
Lab Code		
Test Chamber Manufacturer		
Sample Conditioning	Chamber Temperature	
	Chamber % RH	
	Length of Time in Chamber (hrs.)	

Heat Flux Gauge Data		
Manufacturer		
Calibration Date		
Water Cooled?	Yes	No
Air Cooled?	Yes	No
Calibration Factor	$mV/W/cm^2$	$W/cm^2/mV$

NBS RR – Appendix Data Sheet

Smoke Density Factor in Flaming Mode: Max ^4D_m < 200

Material	Run #	^4D_m @ 4 minutes (uncorrected)	Comments
Foam (White)			
	Average		
////////////////////////	////////////////	//////////////////////	//
Honeycomb Core (Gray/Brown)			
	Average		

NBS RR – Appendix Questionnaire

Where and how are the Hydrocyanic Acid (HCN) samples taken and processed?

_____
_____
_____
_____

Where and how are the Nitrous fumes (NOx) samples taken and processed?

_____
_____
_____
_____

Where and how are the Sulfur Dioxide (SO_2) samples taken and processed?

_____
_____
_____
_____

NBS RR – Appendix Questionnaire

Where and how are the Hydrogen Fluoride (HF) samples taken and processed?

Where and how are the Hydrochloric Acid (HCL) samples taken and processed?

Are Carbon Monoxide samples taken?

NBS RR – Toxicity Data Sheet

Gases	(Please Check the Appropriate Method)			
	Colorimetric Tube	**Flue Gas Analyzer**	**Potentiometry**	**Other**
HCN				
$NO + NO_2$				
SO_2				
HF				
HCL				

If 'Other' please explain:

NBS RR – Toxicity Data Sheet

HCN Toxicity Testing

NO + NO_2 Toxicity Testing

SO_2 Toxicity Testing

HF Toxicity Testing

HCL Toxicity Testing

Run #	Flaming Value (PPM)	
	Foam (White)	HC Core (Gray/Brown)
	ppm	ppm
	ppm	ppm
	ppm	ppm
	ppm	ppm
	ppm	ppm
Average	ppm	ppm

2017 NBS Round Robin

Chauvenet's Criterion (Ds Data Filter)

Z Score is Calculated

- # of STDEV's from population mean
- The closer to zero the better

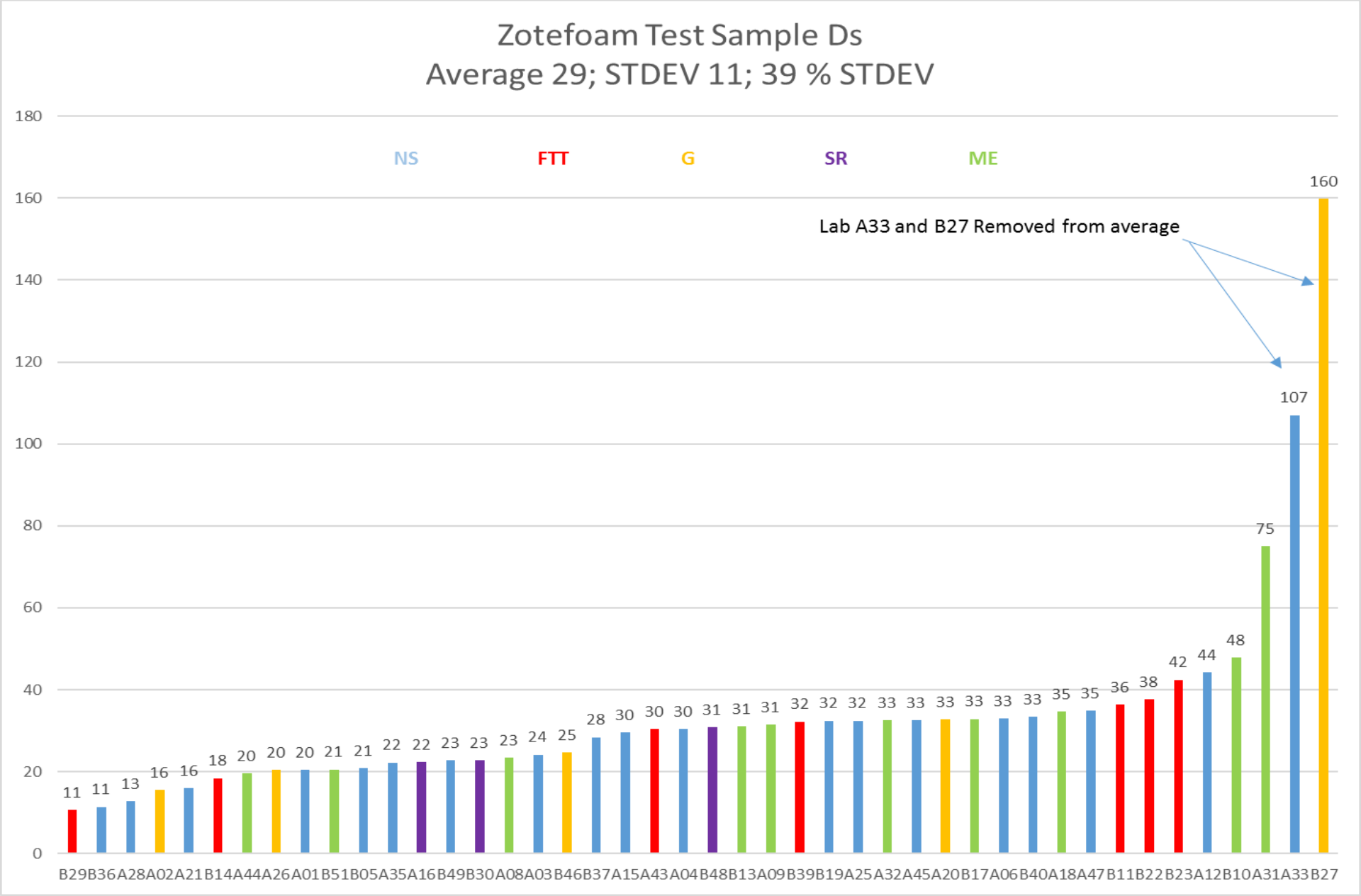
Z Score = (Lab data – Average) / STDEV

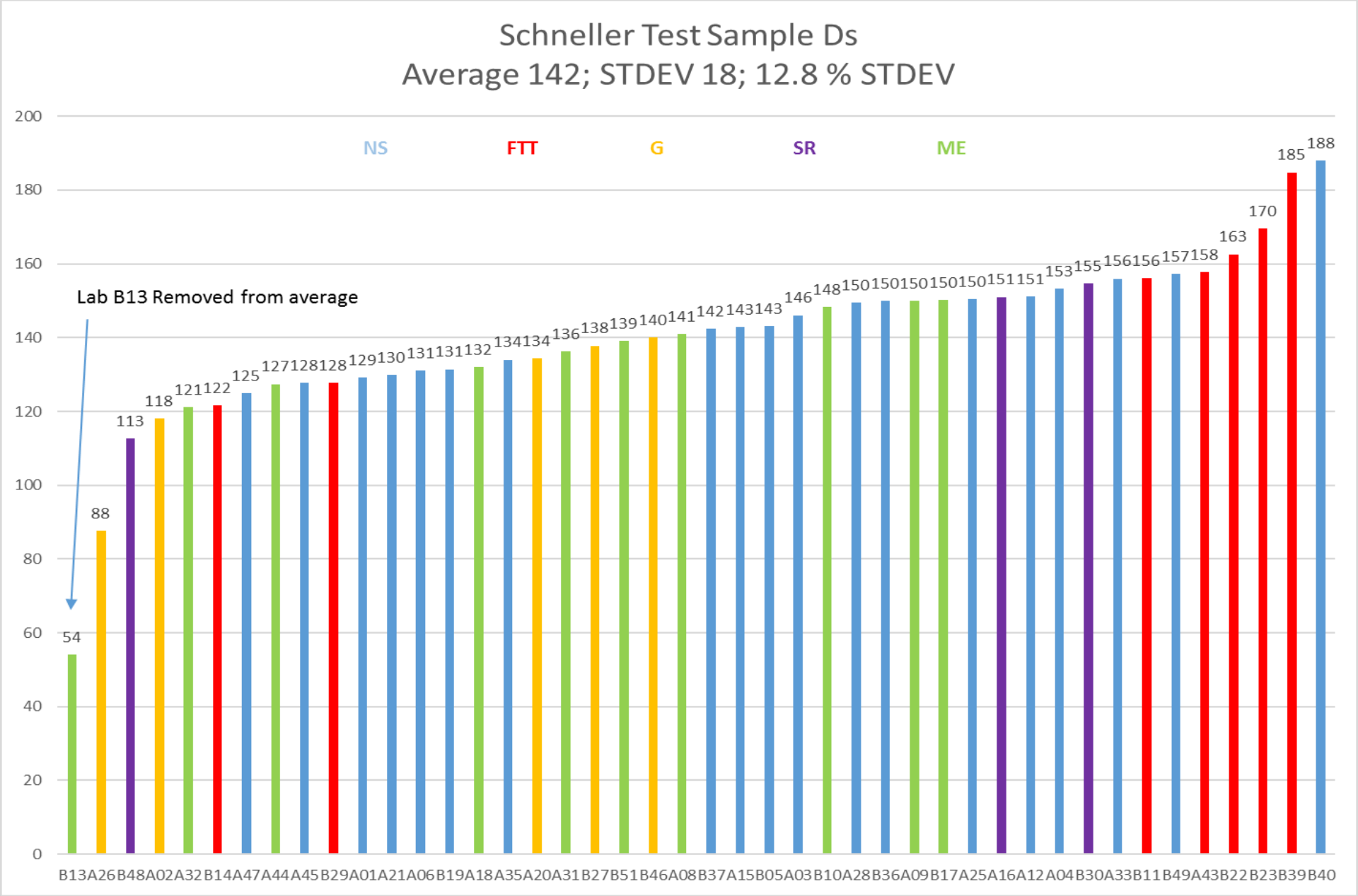
D_{max} is Calculated

- The maximum allowable deviation based on the total number of labs

D_{max} = ABS(NORM.S.INV(1/((4 * # OF LABS))))

Data is rejected if ABS Z Score $\geq D_{max}$


Zotefoam Test Sample Ds
Average 29; STDEV 11; 39 % STDEV
NS
FTT
G
SR
ME
Lab A33 and B27 Removed from average
180
160
140
120
100
80
60
40
20
0
11 11 13 16 16 18 20 20 20 21 21 22 22 23 23 23 24 25 28 30 30 30 31 31 31 32 32 32 33 33 33 33 33 33 35 35 36 38 42 44 48 75 107 160
B29 B36 A28 A02 A21 B14 A44 A26 A01 B51 B05 A35 A16 B49 B30 A08 A03 B46 B37 A15 A43 A04 B48 B13 A09 B39 B19 A25 A32 A45 A20 B17 A06 B40 A18 A47 B11 B22 B23 A12 B10 A31 A33 B27


Schneller Test Sample Ds
Average 142; STDEV 18; 12.8 % STDEV
NS
FTT
G
SR
ME
Lab B13 Removed from average
200
180
160
140
120
100
80
60
40
20
0
54 88 113 118 121 122 125 127 128 128 129 130 131 131 132 134 134 136 138 139 140 141 142 143 143 146 148 150 150 150 150 150 151 151 153 155 156 156 157 158 163 170 185 188
B13 A26 B48 A02 A32 B14 A47 A44 A45 B29 A01 A21 A06 B19 A18 A35 A20 A31 B27 B51 B46 A08 B37 A15 B05 A03 B10 A28 B36 A09 B17 A25 A16 A12 A04 B30 A33 B11 B49 A43 B22 B23 B39 B40

NBS RR – Conclusion/Analysis

- Labs removed from Zotefoam material averaging – A33 and B27
- Labs A26 and B27 used ‘non-cooled’ HFGs
- Labs removed from Schneller material averaging – B13
- Slight trend for FTT units to produce high Ds values (all air-cooled HFG’s)
- Slight trend for Air-cooled HFGs to produce high Ds values (more apparent on Schneller Test Coupons)
- Toxicity discussion in task group to follow

Questions?