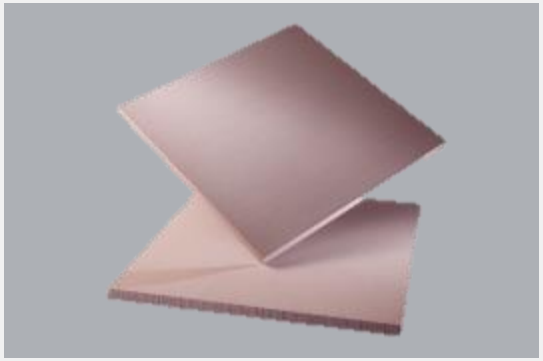


CHOOSING CORE MATERIALS FOR AEROSPACE APPLICATIONS

GENERAL PLASTICS MANUFACTURING CO.

General Plastics supplies aerospace and defense manufacturers with build-to-print flexible foam products and aerospace-grade rigid foam core materials.

WHERE GREAT IDEAS TAKE SHAPE

Established in 1941, General Plastics has been supplying the global aerospace industry for over 60 years. Among its capabilities:

- Sheet stock, machined parts and complex laminates
- Finished parts/build-to-print
- On-site R&D, chemists and scale-up engineers
- On-site analytical/testing capability
- ISO 9001:2008/AS9100C, NQA-1, MIL-I-45208A quality systems
- ITAR compliant

GENERALPLASTICS MANUFACTURING COMPANY

KEY TAKE-AWAYS

COMPOSITE MATERIALS

- Overview
- Industry Trends

FST/OSU

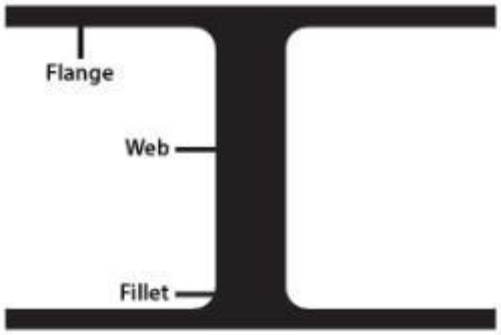
- Testing Process
- Requirements

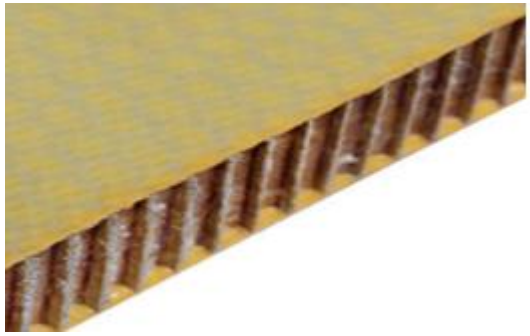
FR-3800 FST FOAM

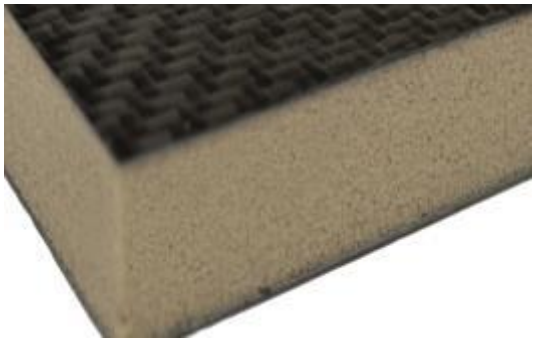
- Features and Benefits
- Applications

GENERALPLASTICS MANUFACTURING COMPANY

COMPOSITE MATERIAL

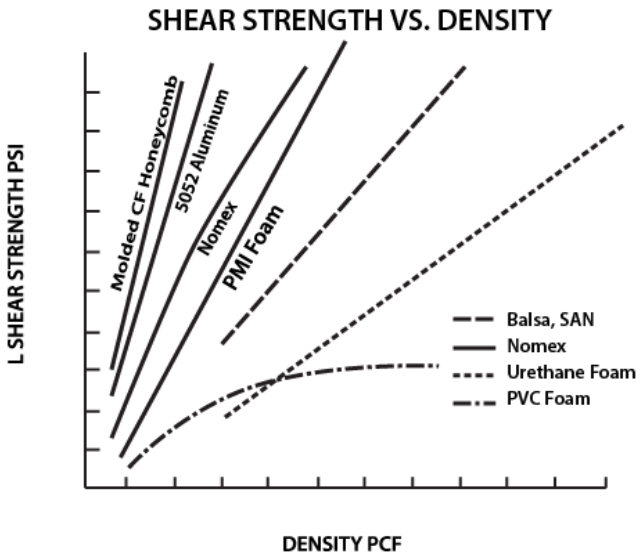




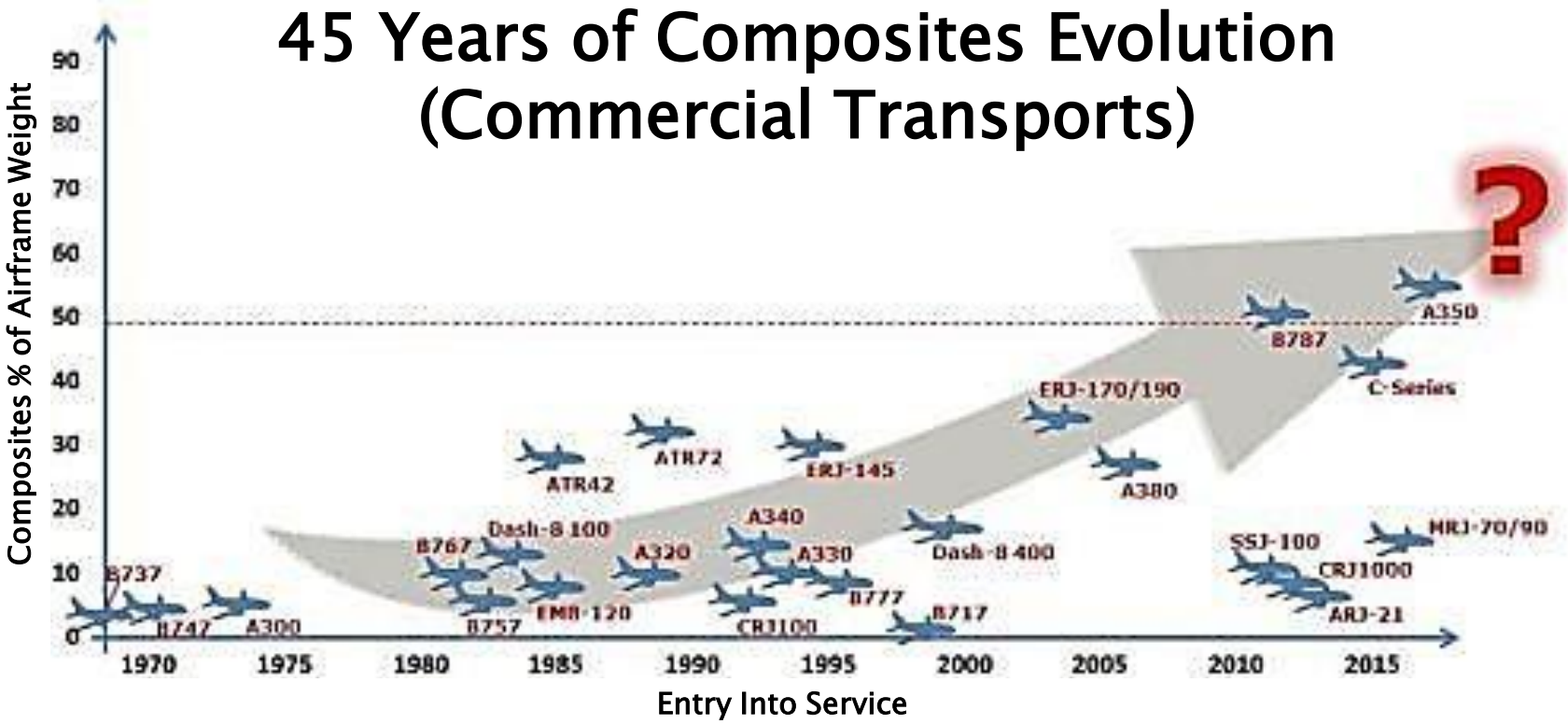


Benefits of Composite Core Materials

- Reduced weight
- Environmental impact
- Increased design capabilities



INDUSTRY TRENDS



Source: www.compositesworld.com

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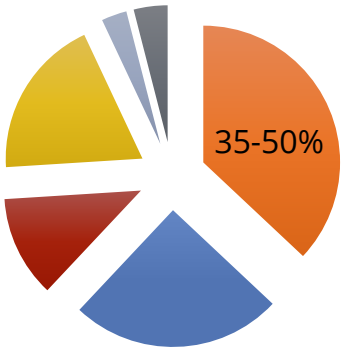
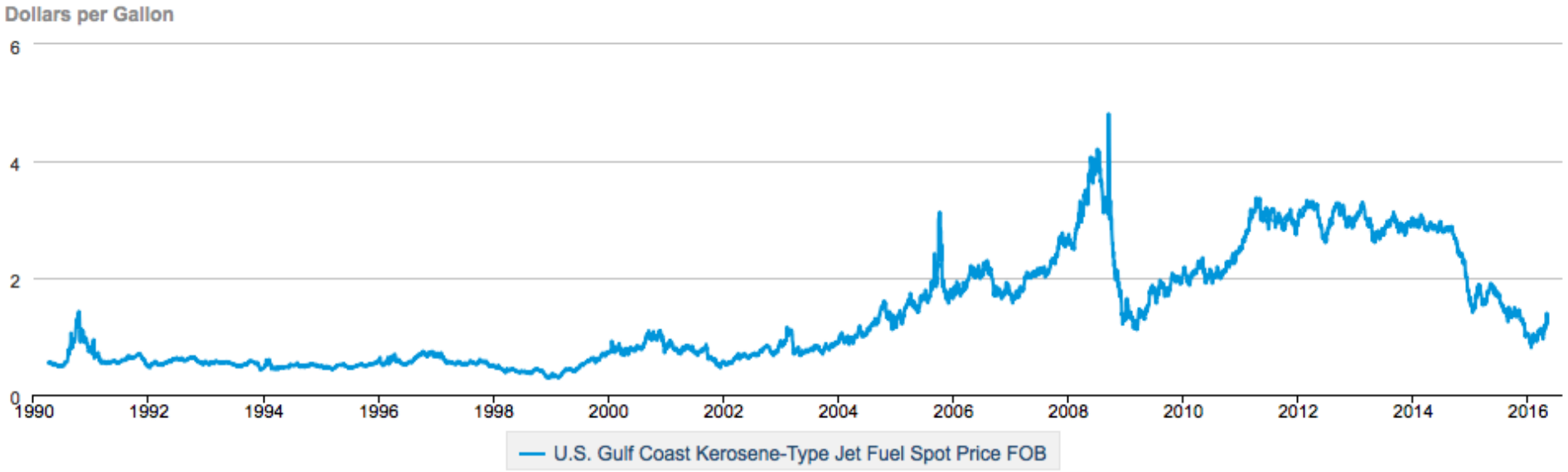
PASSENGER JET OPERATING EXPENSES



Fuel

Source: U.S. Energy Information Administration

U.S. Gulf Coast Kerosene –Type Jet Fuel Spot Price FOB



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TRENDS IN THE AEROSPACE INDUSTRY:

- FAA specifications
- Weight considerations
- Drive down costs
- Other requirements

FST/OSU SPECIFICATION

Fire

Smoke density

Toxicity

Ohio **S**tate **U**niversity

-Heat Release Method

FAA FST/OSU requirements:

65/65/200

FST/OSU SPECIFICATION

Fire

Smoke density

Toxicity

Ohio **S**tate **U**niversity

-Heat Release Method

FAA FST/OSU requirements:

65/65/200

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Ohio **S**tate **U**niversity

-Heat Release Method

FAA FST/OSU requirements:

65/65/200

FST-OSU SPECIFICATION

Fire

Smoke density

Toxicity

Ohio **S**tate **U**niversity

-Heat Release Method

FAA FST/OSU requirements:

65/65/200

FAR AND OEM AEROSPACE SPECIFICATIONS

Table E-I. Industry Test Documentation

FAA Regulation							
Burn Test Description	FAR Paragraph No.	Airbus	British Aerospace	Boeing	Douglas	Shanghai Aircraft Research Institute	ASTM
Piping/hose assemblies	25.1183 (a)		ISO/DIS 2685				
Fire zone wire	25.1359 (b)		ISO/DIS 2685		MIL-C-25038		
Wire insulation	25.1359 (d)	ABD0031/AITM 2.0005 (2)	BACM 1555A		DMS 1501		ASTM-F 777
60-second vertical	25.853 (a)	ABD0031/AITM 2.0002A(2)	BACM 1551A	BSS 7230 F1	DMS 1510		ASTM F 501
OSU heat release	25.853 (a-1)	ABD0031/AITM 2.0006 (2)	BAEP 4508	BSS 7322	DMS 2277		ASTM Modified E 906*
12-second vertical	25.853 (b)	ABD0031/AITM 2.0002B(2)	BACM 1555A	BSS 7230 F2	DMS 1511		ASTM F 501
2.5-in/min horizontal	25.853 (b-2)	ABD0031/AITM 2.0003 (2)	BACM 1555A	BSS 7230 F3	DMS 1505		ASTM F 776
4-in/min horizontal	25.853 (b-3)	ABD0031/AITM 2.0003 (2)	BACM 1555A	BSS 7230 F4	DMS 1507		ASTM F 776
Oil burner seats	25.853 (c)	ABD0031/AITM 2.0009 (2)	BAEP 4508	BSS 7303	DMS 2274	HB 7263	*
Fire containment	25.853(d)		BACM 1555A	Document No. D6T11679	DMS 1513		
30 second, 45 degree	25.855 (a)	ABD0031/AITM 2.0004 (2)	BACM 1555A	BSS 7230 F5	DMS 1508		ASTM F 1103
Oil burner, cargo liner	25.855 (a-1)	ABD0031/AITM 2.0010 (2)	BAEP 4508	BSS 7323	DMS 2273		*
Radiant heat test	TSO-C69a, Appendix 2	TSO		BSS 7315			ASTM F 828
Other NBS smoke	25.853 (a-1)	ABD0031/AITM 2.0007 (2)	BAEP 4625	BSS 7238	DMS 1500		ASTM F 814
NBS smoke (wire)		ABD0031/AITM 2.0008 (2)					
Toxicity		ABD0031/AITM 3.0005 (2)	BAEP 4623	BSS 7239	DMS 2294	HB 7066	
Lot							ASTM D 2863

*ASTM test method being written by subcommittee F7.06.

HOW TO CHOOSE AEROSPACE MATERIALS

Things to Consider:

Processing limitations associated with materials

Strength-to-weight ratio

Cost Performance

Safety Requirements

GENERALPLASTICS MANUFACTURING COMPANY

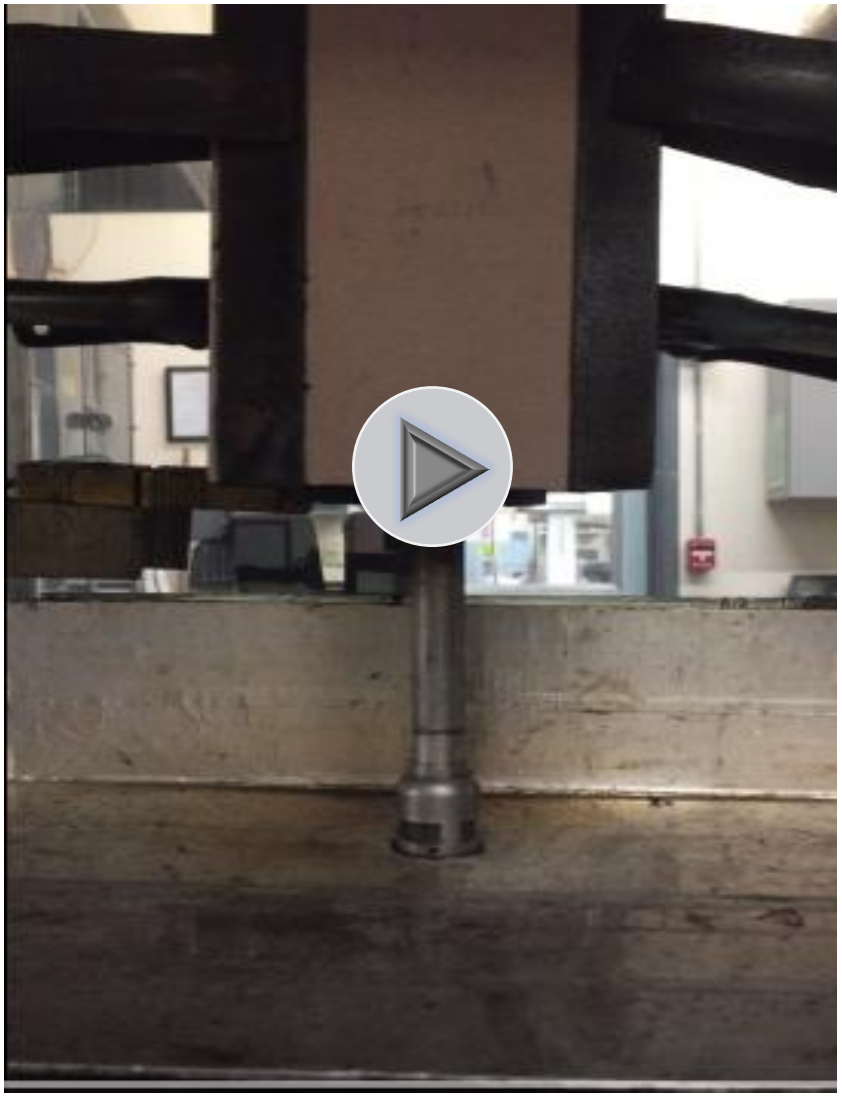
LAST-A-FOAM® FR-3800 FST

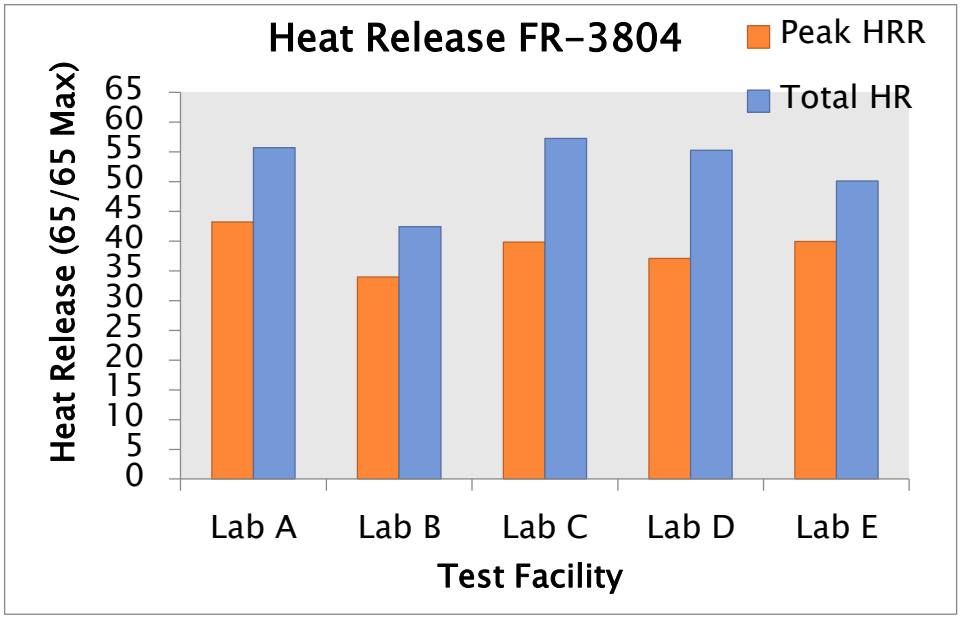
- PU-based core material
- Halogen-free
- Passes FST OSU 65/65/200 specification
- Physical properties congruent with other PU-based core materials
  - 18, 20 pcf densities meet BMS8-133

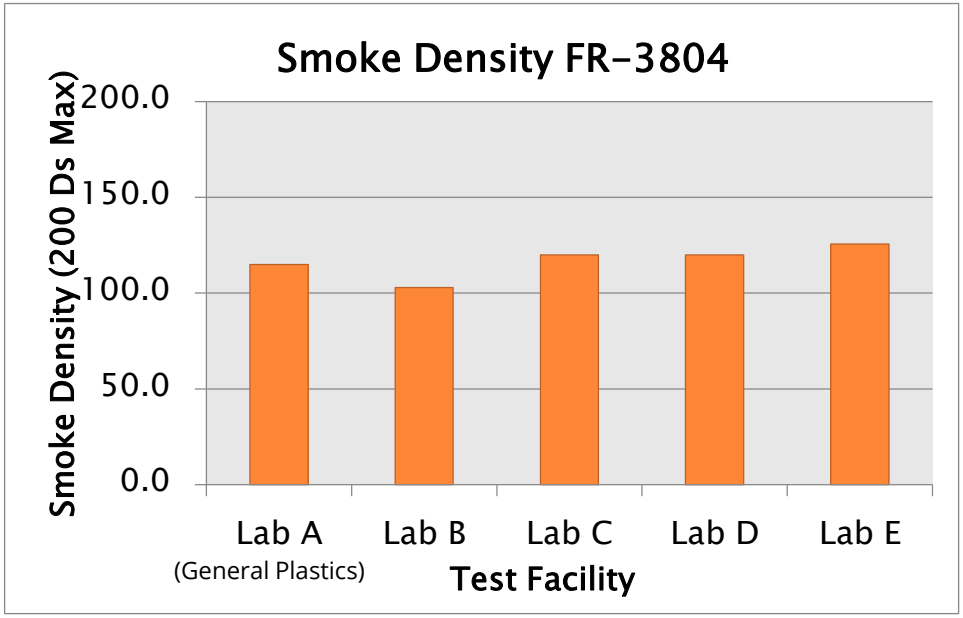
https://www.generalplastics.com/fst-3800.html

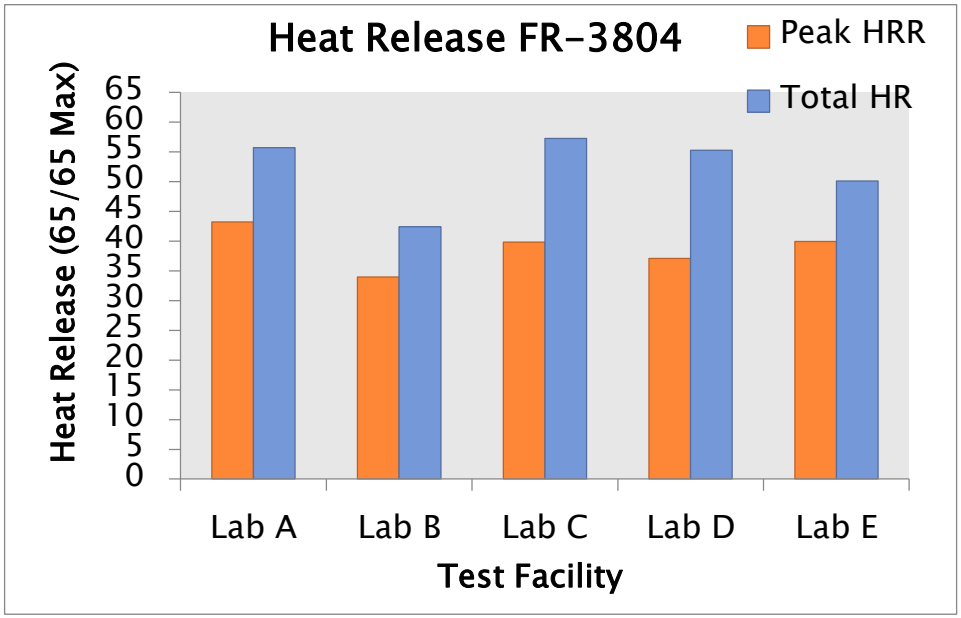
AEROSPACE MATERIALS

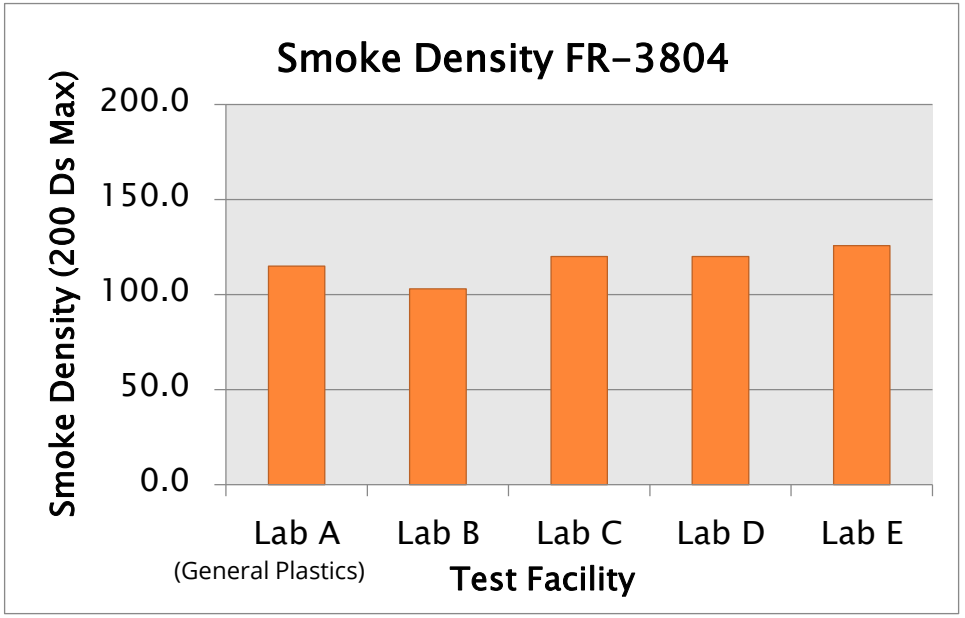
CORE MATERIALS COMPARISON					
	LAST-A-FOAM® FR-3806 FST	**PESU**	**PMI**	**PEI**	**End-Grain Balsa**
Nominal Density (lb/ft3)	6	5.6	4.7	4.7	6.5
C/S (psi)	144	174	217	160	980
C/M (psi)	4359	11188	NA	14938	325000
Shear Strength (psi)	70	203	188	145	268
Shear Modulus (psi)	1120	2320	4205	4641	15600
Tensile Strength (psi)	NA	406	406	240	1000
Tensile Modulus (psi)	NA	NA	13340	7800	16389
Smoke Density	Pass	Pass	Fail	Pass	Fail
Total HR	Pass	Pass	Fail	Pass	Fail
Peak HR	Pass	Pass	Fail	Pass	Fail
Tg (F)	310	425	350	190	>350




Heat Release FR-3804
Peak HRR
Total HR
Heat Release (65/65 Max)
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Lab A
Lab B
Lab C
Lab D
Lab E
Test Facility


Smoke Density FR-3804
Smoke Density (200 Ds Max)
200.0
150.0
100.0
50.0
0.0
Lab A
(General Plastics)
Lab B
Lab C
Lab D
Lab E
Test Facility


Heat Release FR-3804
Peak HRR
Total HR
Heat Release (65/65 Max)
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Lab A
Lab B
Lab C
Lab D
Lab E
Test Facility


Smoke Density FR-3804
Smoke Density (200 Ds Max)
200.0
150.0
100.0
50.0
0.0
Lab A
(General Plastics)
Lab B
Lab C
Lab D
Lab E
Test Facility

FR-3800 FST FOAM OFFERS

- Passes Fire/Smoke/Toxicity (FST) requirements
- Meets OSU 65/65 heat release standards
- Alternative to thermoplastics and honeycomb in FST applications
- Withstands process temperatures up to 310°F
- Range of densities: 3 - 40 pcf
- High strength-to-weight ratio from crosslinked structure
- Bonds well with composite skins
- Resistant to most chemicals and solvents
- Will not support fungal growth
- No edge-closing or filling needed

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OPTIONS FOR USE

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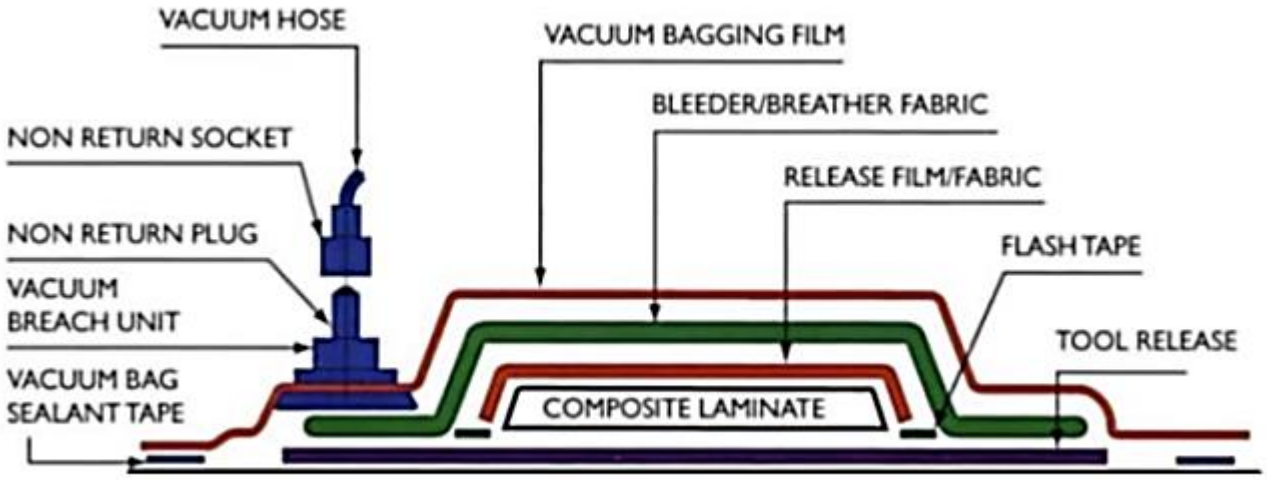
THERMOFORMABLE

- Easy processing
- Drape / mold forming
- Can form all densities

SANDWICH PANEL LAYUPS

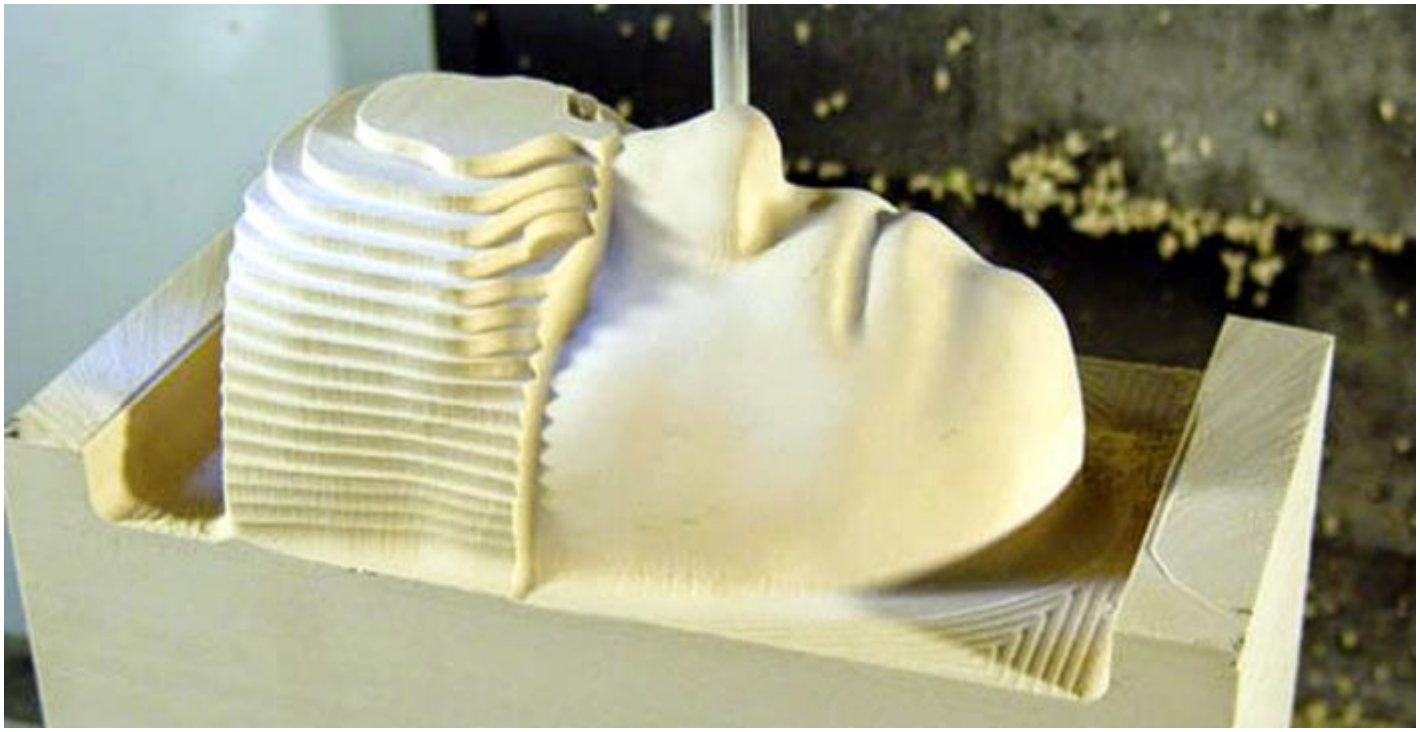
- Process using standard vacuum bag layup techniques
- Processing temperatures above 275° F



POUR IN PLACE PARTS

- High levels of detail
- Complex shapes without machining
- Smooth or textured skin

HIGH MACHINABILITY



- Smooth surface finish
- Minimal dust

Conclusion

COMPOSITE MATERIALS

- Weight reduction
- Enhanced Performance
- Overall cost reduction

FST/OSU

- FAR flammability specs
- Materials testing

FR-3800 FST FOAM

- High strength to weight ratio
- Low cost material
- Versatile processing

GENERALPLASTICS MANUFACTURING COMPANY

Q & A

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