



GRAFOAM® CARBON FOAM GRADES

		FPA-02	FPA-05	FPA-10	FPA-15	FPA-20	FPA-30	FPA-35
GRAFOAM® Grades								
Bulk Density	g/cm ³	0.030	0.081	0.166	0.244	0.324	0.504	0.560
	lb/ft ³	1.9	5.1	10.4	15.2	20.2	31.5	34.9
Specific Resistance (WR)	μOHMm	15000	8723	3542	1967	913	620	400
	Ohm-in	0.59	0.34	0.14	0.08	0.04	0.02	0.02
Specific Resistance (AR)	μOHMm		5801	2510	1608	747	544	
	Ohm-in		0.23	0.10	0.06	0.03	0.02	
Young's Modulus	GPa		0.10	0.50	1.00	2.00		3.50
	psi x 10 ⁶		0.01	0.07	0.15	0.29		0.51
CTE (30-100°C)	x10 ⁻⁶ /°C	2.3	2.3	2.3	2.3	2.3	---	2.3
	x10 ⁻⁶ /°F	1.3	1.3	1.3	1.3	1.3		1.3
Thermal Conductivity (room temp.) WR	W/mK	0.06	0.08	0.12	0.17	0.21	0.32	0.30
	BTU/hr-ft-°F	0.03	0.05	0.07	0.10	0.12	0.18	0.17
Thermal Conductivity (room temp.) AR	W/mK		0.07	0.11	0.15	0.21	0.30	
	BTU/hr-ft-°F		0.04	0.06	0.09	0.12	0.17	
Flex Strength (WR)	MPa		0.4	1.2	2.1	3.8	5.4	
	psi		64	175	300	550	786	
Flex Strength (AR)	MPa		1.0	2.3	3.9	5.0	7.9	
	psi		140	335	566	720	1141	
Compressive Strength (WR)	MPa	0.2	1.0	5.2	10.0	18.0	40.6	60
	psi	29	143	760	1446	2614	5892	8702
Compressive Strength (AR)	MPa		0.6	3.2	7.5	13.1	30.1	
	psi		83	470	1086	1897	4370	
Shear Strength (torsional)	MPa	0.05	0.24	1.1	1.7	2.6	3.9	
	psi	7	35	160	247	377	566	
Tensile Strength (WR)	MPa		0.67	1.91	3.19	4.6	6.14	
	psi		98	276	462	666	890	
Tensile Strength (AR)	Mpa		0.37	1.02	2.18	3.5	4.63	
	psi		54	148	316	507	671	
Gas Permeability	Darcy				1	0.2	---	0.02
Apparent porosity	%	98.6	96	90	86	80		61
6" x 18" x 72" 15cm x 45cm x 180cm		✓	✓	✓	✓	✓		
6" X 36" X 72" 15cm x 90cm x 180cm		✓	✓	✓				
4" x 36" x 36" 10cm x 90cm x 90cm							✓	✓

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GRAFOAM®

CARBONFOAM Solutions

CORE MATERIALS

GRAFOAM® carbon foam is an innovative, open-cell, rigid carbon foam material that was developed to provide a series of integrated solutions as a core material for composite sandwich structures and panels



**2006
R&D 100
AWARD
WINNER**



FEATURES AND BENEFITS

- Sustained fire resistance
- Low thermal conductivity
- High temperature capable
- Electromagnetic shielding
- Chemically and fungus inert
- High strength to weight ratio
- Bonds easily with laminates
- Easily machined to tight tolerances
- Acoustic shielding
- No off-gassing



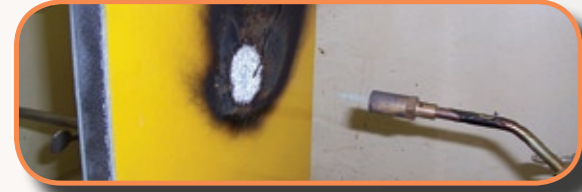
GRAFOAM® carbon foam is a multi-functional core material that has been used in various configurations ranging from GrafTech's SafeTFoam® reinforced composite panels to multi-material composite structures.

SAFETFOAM™ PANELS

GRAFOAM® SafeTFoam™ is a sandwich panel of fiberglass encased carbon foam that is reinforced by strength enhancing ribs.

SafeTFoam™ panels have enhanced mechanical properties and excellent fire and impact resistance suitable for use in safe houses and other structures. Panel sizes up to 10' x 58' / 3 m x 18 m have been constructed and can be custom built to each customer's specifications.

LAMINATED PANELS



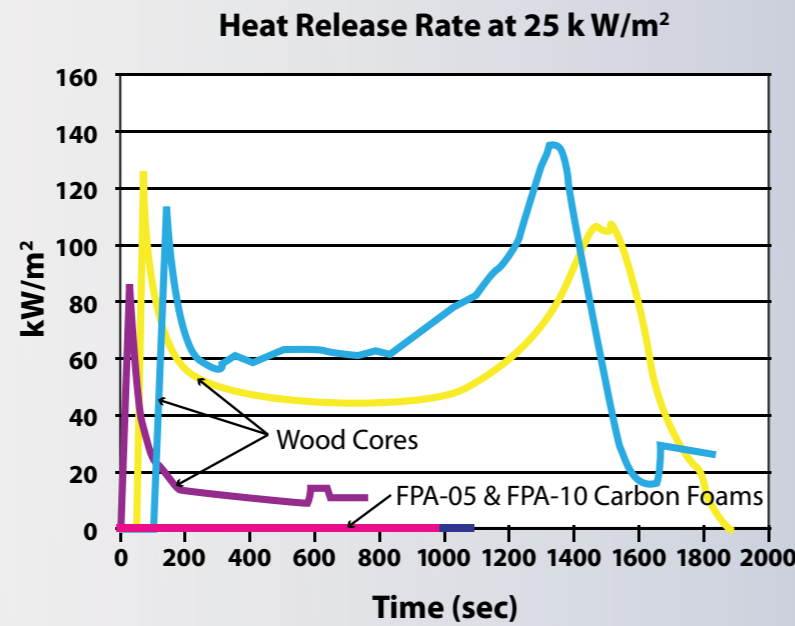
GRAFOAM® carbon foam seals easily and bonds well to laminates including glass fiber, aramid fiber, carbon fiber, polyester, vinyl ester, epoxy, phenolic, thermoplastics, concrete and GRAFOIL® flexible graphite.

Aside from serving as the core in a basic panel, GRAFOAM® carbon foam can be used in combination with various materials because of its chemical inertness.

GRAFOAM® CARBON FOAM

GRAFOAM® carbon foam is produced in densities ranging from 2 lb/ft³ (32kg/m³) to 35 lb/ft³ (560kg/m³) and is offered in a variety of sizes. As a core material in sandwich panels, GRAFOAM® carbon foam can be used in doors, walls, ceiling panels, and flooring for:

- Safe Rooms
- Building Construction (commercial and residential)
- Transportation (marine, aviation, and ground vehicles)
- Military Applications
- Refrigeration
- Storage Facilities



FIRE AND TEMPERATURE

GRAFOAM® carbon foam material provides a multi-hour ASTM fire rating while saving space and weight. There is no flame spread or off-gassing with GRAFOAM® material.



TEST	MATERIAL	RESULTS	COMMENTS
Smoke Development (ASTM E-84)	GRAFOAM® carbon foam	0/0	0 Smoke development and 0 fire spread
Fire Testing (ASTM E-119)	GRAFOAM® carbon foam with Gypsum	2hr 30 min	Tested 3.5" thick GRAFOAM® with steel studs with 5/8" Type X Gypsum Board
Thermal resistance (R-value/inch)	FPA-05 FPA-02	2 3	GRAFOAM® carbon foam is a thermal insulator
ISO 1182	GRAFOAM® carbon foam	Non-Combustibility	Classified non-combustible

SAFETFOAM™ PANELS

LIGHTNING

A preliminary series of lightning tests have been conducted under a European Union lightning materials program in the United Kingdom at Culham Lightning Center in Culham Oxfordshire. A lightning strike is typically a high amplitude direct-current pulse with a well-defined waveform. Preliminary testing was conducted on FPA-20 GRAFOAM® carbon foam by itself to determine how it would withstand high pulse – short duration (type A/D) lightning discharges as well as longer duration – lower amperage (type B/C) sustained discharges.



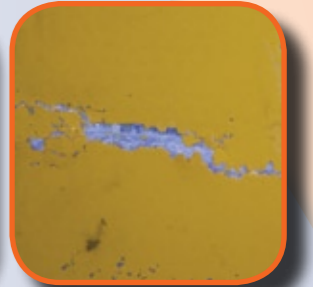
STRIKE TYPE	DESCRIPTION	TIME	CURRENT	CARBON FOAM RESULT
A	Initial Strike	200usec	200000A	Pass
B	Intermediate current	~200usec	11000A	Pass
C	Continuing current	0.75sec	900A	Pass
D	Restrike	200usec	100000A	Pass

MECHANICAL

STORM IMPACT TESTS

The storm impact tests consisted of multiple impacts on 4 x 4 single panels.

SafeTFoam™ passed ALL protocols.



PROTOCOL	DESCRIPTION	PROJECTILE	PROJECTILE SPEED	IMPACT FORCE
1	Hurricane Envelope	Wood 2"x4" (9 lbs)	34 mph	350 ft-lbs
2	Hurricane shelter (low speed)	Wood 2"x4" (15 lbs)	66 mph	2180 ft-lbs
3	Hurricane Shelter (high speed)	Wood 2"x4" (15 lbs)	80 mph	3200 ft-lbs
4	Tornado (250 mph wind speed)	Wood 2"x4" (15 lbs)	100 mph	4964 ft-lbs
	300 mph wind speed	Wood 2"x4" (15lbs)	125 mph	7757 ft-lbs

SHIELDING

ELECTROMAGNETIC TESTS

GRAFOAM® material's high conductivity makes it an ideal material for EMI shielding applications, meeting NSA 94-106 requirements for shielded enclosures in the military.

ELECTROMAGNETIC WAVE SHIELDING PROPERTIES OF GRAFOAM® CARBON FOAM (100-3000 MHz)

MODE	FPA-02	FPA-10	FPA-20
Reflection	65-70%	80-92%	95%
Transmission	2%	0%	0%
Absorption	30-35%	10-20%	2-5%

ACOUSTIC TESTS

Tested as an acoustic shield and sound absorber.

TEST	MATERIAL	RESULTS	COMMENTS
Sound Transmission Class STC (ASTM C-423)	GRAFOAM® carbon foam with Type X Gypsum	STC 42	Sound transmission loss of 42dB for a 3.5" thick GRAFOAM® carbon foam material wall with steel studs and 5/8" Type X Gypsum
Noise Reduction Class NRC (ASTM C-423)	GRAFOAM® carbon foam with Type X Gypsum	NRC: 0.30 SAA: 0.32	3.5" of GRAFOAM® FPA-05 carbon foam material

Tabulated results apply to SafeTFoam™ panels with 3/4" x 2 1/2" webs. Thermal and mechanical properties vary with web dimensions.