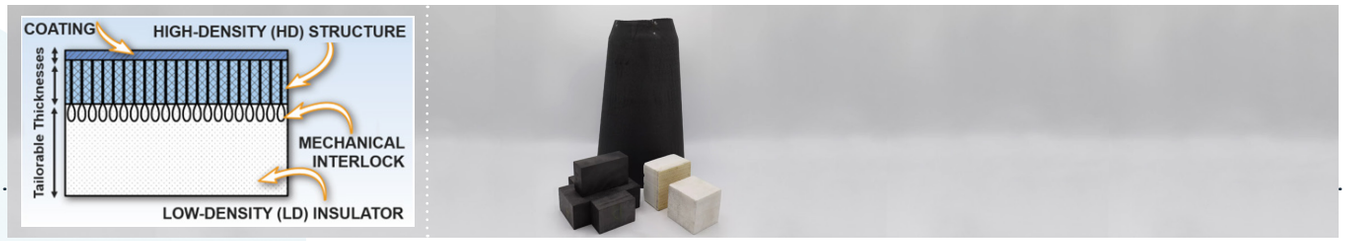
MULTIFUNCTIONAL COMPOSITES



- Multipurpose composites with structural and ablative performance at reduced densities
- Lower manufacturing costs and more streamlined processing compared to currently used Thermal Protection Systems (TPS)
- Integrated low-thermal-conductivity insulation enables extended-duration flights

Textron Systems has developed and tested integrated high density/low density (HD/LD) structural composites as lightweight thermal protection for extended-duration hypersonic applications. These multifunctional composites are material-agnostic and tailorable to specific environments and vehicle trajectories.

Multifunctional composites are manufactured in a variety of material compositions of robust, outer composite layers integrated with low density, insulative layers. The two layers are mechanically interlocked with high-strength fiber and chemically bonded, making them capable of accommodating harsh aerothermal forces during operation. The thicknesses of all layers are readily tailorable to provide appropriate ablation resistance, structural rigidity, and thermal as needed for the application. All structures are readily compatible with oxidation-resistant coatings. Textron Systems has produced flight-tested examples for leading edges and acreage window thermal protection systems.

Function	TPS Material		Density (g/cm^3)	Tensile Strength (MPa)	Compressive Modulus (GPa)	CTE (μm/m-K)	Thermal Conductivity (W/m-K)	Specific Heat (J/kg-K)
Leading Edge	3D C/C HD/LD	HD	1.4	110	55	0.0	3.8	630
		LD	0.19	2.1	0.50	0.1	0.07	1260
Acreage	3D C/P HD/LD	HD	1.5	340	34	0.6	0.42	880
		LD	0.21	2.7	0.08	3.8	0.07	1260
Acreage	3D Q/P HD/LD	HD	1.60	280	21	3.1	0.28	1100
		LD	0.21	2.8	0.07	3.8	0.07	1260
Aperture	3D Q/DI HD/LD	HD	1.69	280	18	0.7	0.43	670
		HD	0.22	3.1	0.56	1.5	0.09	-