

01 | PRODUCT ARCHITECTURE

An ultra-lightweight, cold-cured bio-mineral composite engineered for next-generation aerospace and high-performance mobility cabins. Displaces petrochemical resins and heavy mineral veneers via a cold-curing inorganic magnesium matrix, structural aramid core, and an integrated carbonaceous micro-interlayer. The architecture functions simultaneously as a Class-A interior partition, an active surface micro-heater, and a high-loss structural vibration damper.

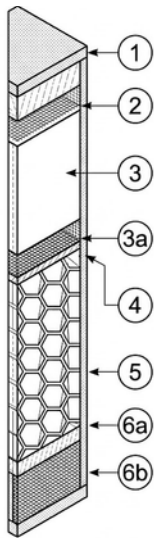


FIG. 1 — COMPOSITE ARCHITECTURE & LAYER SCHEMATIC

- 1: Dense Mineral Tactile Surface
- 2: Continuous Mineral Fibre Reinforcement
- 3: Bio-Syntactic Viscoelastic Core (NVH Attenuation)
- 3a: Embedded Conductive Carbon Interlayer & Busbars
- 4: Inorganic Thermal Barrier Interface
- 5: Aerospace-Grade Aramid Honeycomb (Nomex)
- 6a: High-Performance Coupling Film
- 6b: Structural Mineral Backing Textile

02 | STRUCTURAL DAMPING & NVH (ASTM E756)

The panel operates on an internal Constrained Layer Damping (CLD) principle. Cyclic shear deformations are converted into micro-thermal loss within the viscoelastic bio-syntactic core layer, preventing acoustic transfer and motor harmonics.

TABLE 1 — STRUCTURAL DAMPING & WEIGHT BENCHMARK (ASTM E756)

Material Configuration	Loss Factor (η)	Resonant Behavior	Parasitic Weight Penalty
Aluminium 2024-T3	~0.001	Severe structural ringing	+2.5 to 4.0 kg/m ² (Butyl sheets)
Carbon / Epoxy (CFRP)	0.008 – 0.015	High peak resonance	+1.5 to 2.5 kg/m ² (Damping pads)
Aerospace Nomex / CFRP	0.018 – 0.025	Standard acoustic barrier	Requires secondary acoustic insulation
LeTugrance Bio-Mineral	0.060 – 0.090	Superior decay rate (3–4× higher)	0.0 kg/m ² (Zero secondary deadener)

OEM Value Proposition:

Eliminates up to 15–20 kg of secondary acoustic deadweight per vehicle cabin, while attenuating high-frequency electric powertrain whine (1–5 kHz).

03 | ACTIVE THERMAL MASS PERFORMANCE

Integrated radiant micro-heating eliminates the need for parasitic convective ducting and active dehumidification units.

- **Operating Voltage:** 5V – 48V DC (Touch-safe, low-voltage certified).
- **Max Power Density:** ~120 W/m² (Active duty).
- **Thermal Retention:** 48 minutes passive heat release post power-off.
- **Duty Cycle:** 16.7% active pulse maintains cabin surface +2°C above ambient dew point to completely eliminate hidden fuselage condensation ("cabin rain").

PHYSICAL SPECIFICATIONS

- **Areal Weight:** ~4.5 kg/m² (Configuration dependent).
- **Nominal Thickness:** 8.0 mm – 12.0 mm.
- **Matrix Curing:** Ambient Cold-Curing (Zero-autoclave, room temperature solidification).
- **Surface Resistance:** Anti-static, Cerakote-sealed hydrophobic barrier (zero water absorption).

04 | SAFETY & ENVIRONMENTAL COMPLIANCE

Engineered from the ground up for strict transport safety and closed-loop circular economy.

Fire, Smoke & Toxicity (FST Testing):

- **Flammability:** Intrinsic non-combustibility via endothermic hydrate mineral release.
- **Vertical Burn (60 s):** Self-extinguishing in < 8 seconds (FAR 25.853 compliant).
- **Flaming Droplets:** 0 (Zero melt, zero flaming drip).
- **Certification Target:** FAR/CS 25.853 (Aerospace) & IMO FTP Code Part 1 (Marine).

Environmental & ESG Performance:

- **Mineral Matrix Embodied Carbon:** Net-Zero (0.0 kg CO₂-eq/kg) via room-temperature mineralization.
- **Total Assembly Carbon Footprint:** 2.15 kg CO₂-eq/m² (10× lower than aerospace phenolic/epoxy panels).
- **Biogenic Carbon Storage:** -0.24 kg CO₂-eq/m² (Fixed bio-particulates & stable bio-char matrix).
- **VOC Off-Gassing:** 0.0 mg/m³ (Zero VOC, completely odorless and non-toxic).
- **Circularity:** 100% Recyclable closed-loop (mechanically pulverised into structural aggregate filler).
- **Operational Energy Payback:** < 3 months (Saves 75 kWh/m²/year compared to convective HVAC systems).

05 | TARGET MOBILITY MARKETS

- **Aerospace & VIP Aviation:** Ultra-lightweight sidewall partitions, acoustic bulkheads, and ceiling linings. Active 16.7% pulse heating eliminates hidden moisture accumulation behind cabin walls without heavy dehumidifiers.
- **eVTOL & Electric Mobility:** Structural battery enclosure covers and lightweight passenger cockpits. Combines a high-temperature thermal barrier for thermal-runaway protection, inherent EMI shielding, and motor NVH dampening.
- **High-Speed Marine & Superyachts:** Direct, non-combustible lightweight replacement for heavy luxury stone veneers in galleys and crew bulkheads. Immune to salt-spray and high humidity environments.
- **Luxury Transport & Smart Architecture:** Dry-assembly structural interior partitions with built-in low-voltage radiant heating, zero-VOC indoor air quality, and authentic stone tactile aesthetics.

06 | VALIDATION & CERTIFICATION ROADMAP

- **Technology Readiness:** TRL 4 (Laboratory validation of multi-functional coupons: mechanical, electrical, and flame testing completed).
- **Manufacturing Model:** Decoupled UK-based production combining precision cold-casting with low-energy vacuum consolidation.



FIG. 2 — VERTICAL BURN TEST (ZERO MELT/DRIP)



FIG. 3 — HYDROPHOBIC SURFACE (ZERO MOISTURE ABSORPTION)