

Phase Change Material PCM Heat Exchangers



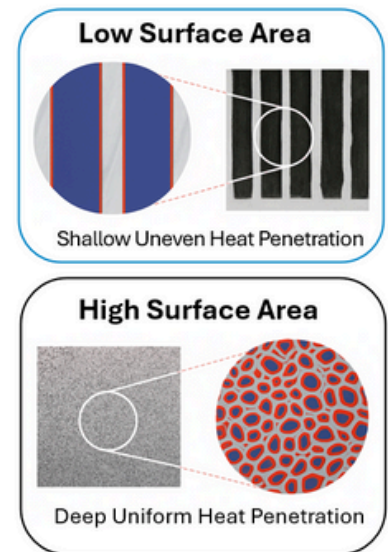
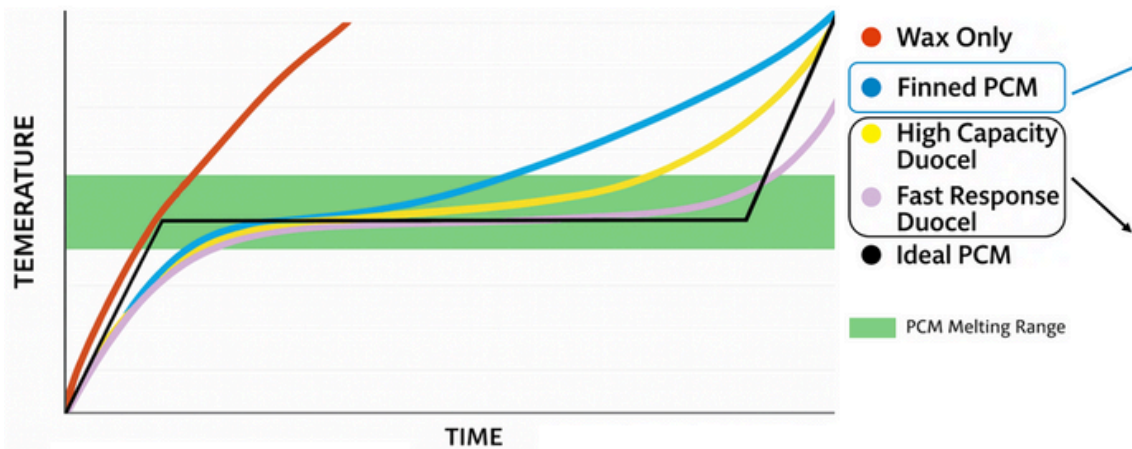
LIGHTWEIGHT, RELIABLE THERMAL MANAGEMENT

What are PCM Heat Exchangers?

PCM Heat Exchangers or Thermal Batteries, absorb heat quickly by melting paraffin wax.

Space Heritage | Small Footprint | No Moving Parts

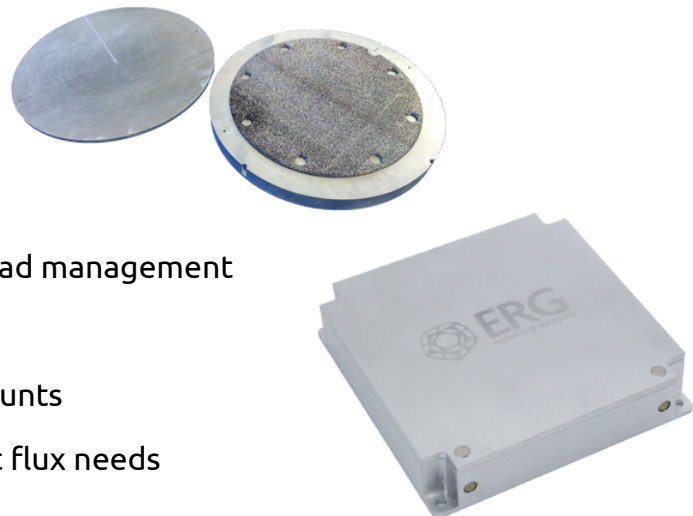
PCM PERFORMANCE



Why Foam Improves Performance

Duocel® Foam drives heat deep into the PCM through its uniform skeletal structure, delivering:

- **Isothermal Stability** – Holds target temp longer
- **High Heat Flux** – Faster charge/discharge for peak load management
- **Quick Response** – Cycles up to 20% faster than fins
- **Longer Life** – Reduces PCM stress for higher cycle counts
- **Scalable Design** – Tunable for energy density or heat flux needs



Duocel® Foam uniquely combines the functions of a Phase Change Heat Exchanger for transient spikes and a Phase Change Thermal Battery for reliable energy storage across mission cycles.

Flight Proven Performance

ESA ExoMars Case Study

ERG Designed three Duocel® PCM heat exchangers for the European Space Agency's ExoMars program

- **Managed 35W (97kJ) of heat for 46 minutes** during landing
- Maintained equipment below 40°C with $\Delta T < 2^{\circ}\text{C}$

Benefits of Duocel® Heat Exchangers

Enhanced Thermal Conductivity

- Dense network of open-cell ligaments provides maximum surface area and uniform heat distribution
- Reduces internal gradients, enabling faster, more consistent thermal charge & discharge

Compact & Lightweight

- Meets aerospace weight and volume constraints without sacrificing performance

Highly Customizable

- Engineered through tunable foam density, pore size, material and geometry to meet any heat flux or form factor requirements

Strong Structural Properties

- Foam structure supports PCM, maintains rigidity and can be brazed or bonded for robust interfaces.

Proven Environmental & Vibration Compliance

- Designed and validated for space, aerospace and defense mission conditions

Manufacturing & Lifecycle Support

Vertically Integrated

- Engineering design, thermal modeling, prototyping, testing, and production under one roof reducing lead times

Decades of experience

- ERG has been providing foam based PCM solutions since the 1990's

Recognized Supplier Excellence

- Pratt and Whitney Supplier of the Year & IHI Supplier of the Year



Ready To Transform Your Thermal Management Systems?

Partner with ERG Aerospace for innovative solutions that prioritize performance, sustainability, and integration.

DELIVERING PRECISION,
POWER, AND SUSTAINABILITY
IN THERMAL MANAGEMENT



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