National Aeronautics and Space Administration

FY24 Strategic Initiatives Research and Technology Development (SRTD)

Additively Manufactured Rover Chassis with Integrated Thermal Control for Extreme Cold Environments

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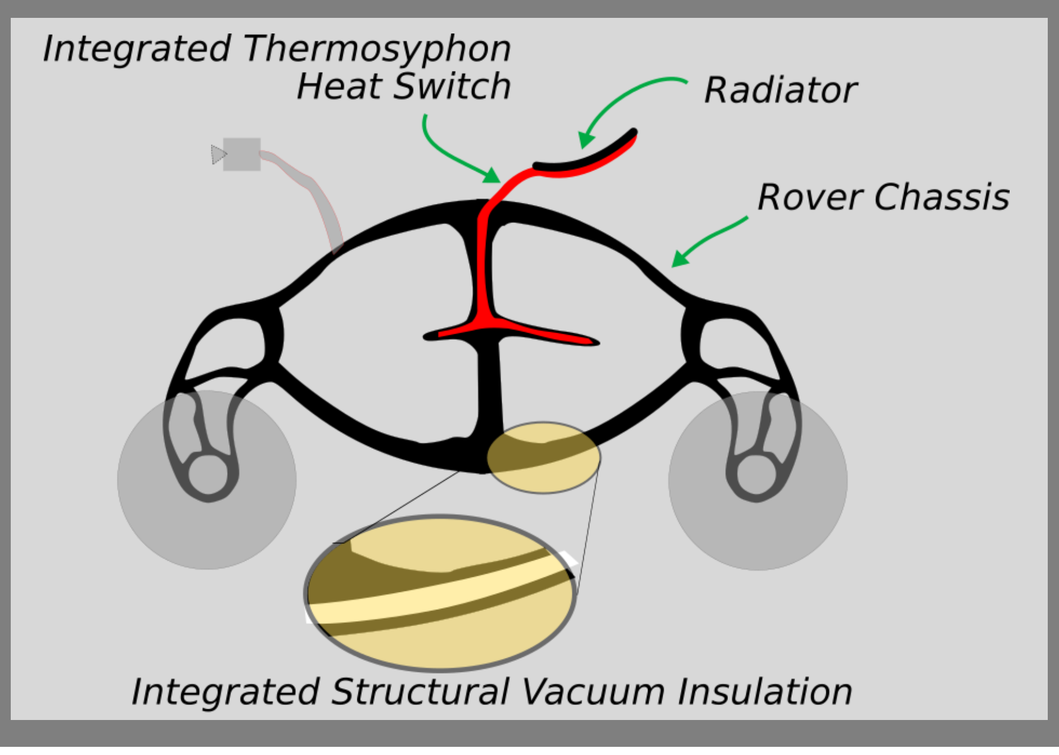
Strategic Focus Area: Lunar Science/ Moon and Mars Extreme Cold, Steep Terrain Rover **| Strategic Initiative Leader:** John D Baker

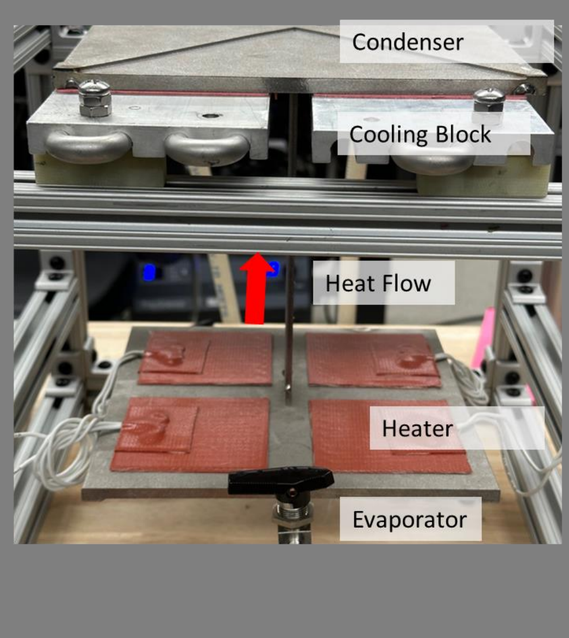
Objectives:

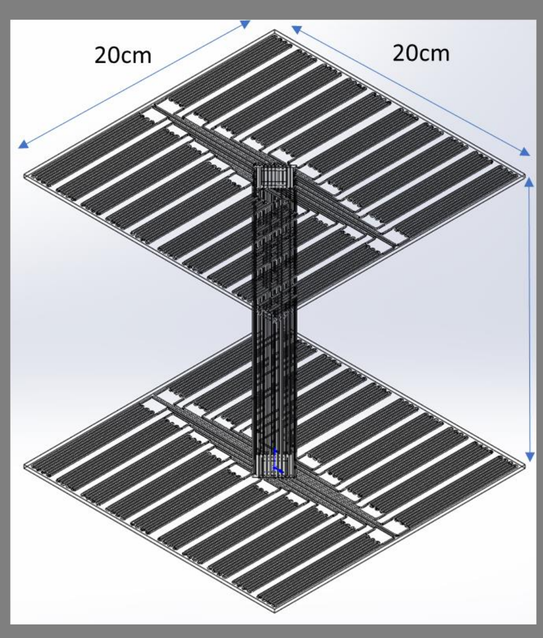
The goal of this three-year strategic RTD task is to develop an topologically optimized additively manufactured (AM) rover chassis that incorporates a heat switch and insulation elements to enable new mission concepts to the Moon and Mars. The rover chassis is a mutlifunctional thermal-structural component. This year was the second year of the task and the high-level goals were to mature the basic thermal technology elements (AM heat switch and AM thermal insulation), as well as develop a notional rover chassis design. The final goal will be to qualify at TRL 5 an AM rover chassis that has been thermally/structurally optimized and incorporates a heat switch and insulating elements.

CONCEPT



AM Two-Phase Heat Switch





Internal Channels

Mechanical and Thermal Topology Optimization

Simulation in Thermal Desktop

FEA displacement - Titanium

Thermal Testing Results

Successful Demonstration

- Stable operation over 3.5 hrs and 20hrs
- **ON Conductance: 10.4 W/K** (Goal 10W/K)
  Ti-OHP Thermal Conductivity is ~30472 W/m/K (vs 7 W/m/K, Titanium)
- **OFF Conductance: 0.0029 W/K** (Goal 0.001 W/K)

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RPD-000 Clearance Number: CL#00-0000

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