THERMAL MANAGEMENT TECHNOLOGIES

Space Related Technology

Thermally Efficient Deployable Radiators

A thermally efficient approach to radiative cooling using advanced isothermal radiator surfaces and a high thermal conductance hinge

Main Features:

- *High effective thermal conductance radiator panel*
- *High thermal conductance hinge connects radiator to spacecraft*
- *Low mass - tightly packaged solution*
- *Wide operational temperature: -30 °C to +65 °C*
- *Multi-chambered to eliminate single point failures*

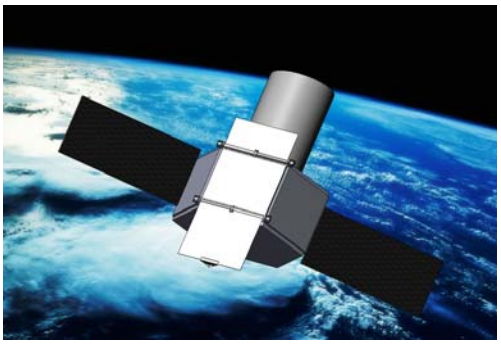
Key Benefits:

- *Highly efficient isothermal radiator surface*
- *Radiator operates near the spacecraft temperature to reduce area and mass*
- *Future plans are to incorporate a passive, thermostatically controlled mechanism for variable area capability*

Efficient-Deployable Thermal Radiators

Thermally Efficient Deployable Radiators for spacecraft thermal control are being developed at TMT. The radiator high thermal efficiency is brought about by integrating an isothermal radiator surface with a high thermal conductance hinge to minimize the temperature difference between the radiator and the spacecraft.

Making the units deployable allows users to pack more radiating surface into a smaller launch package. If desired, the radiators can also be fixed.



Spacecraft Thermal Radiator Concept

Radiating Surface

The radiating surface consists of TMT Thermal Control Panel technology with graphite composite external skins to reduce mass and increase radiator stiffness. Comparing a 100 W TMT radiator with a 0.5 cm thick aluminum radiator of the same size, analysis shows 4 °C and 83 °C difference across the radiator surface for the TMT unit and aluminum plate respectively.

Thermally Conductive Hinge

The hinge provides high thermal conductance and low friction for ease of opening. It is rigidly connected to the radiator on one side and to the spacecraft on the other side. An actuator deploys the unit upon command. Test data show the hinge thermal resistance is < 0.09 °C /W.

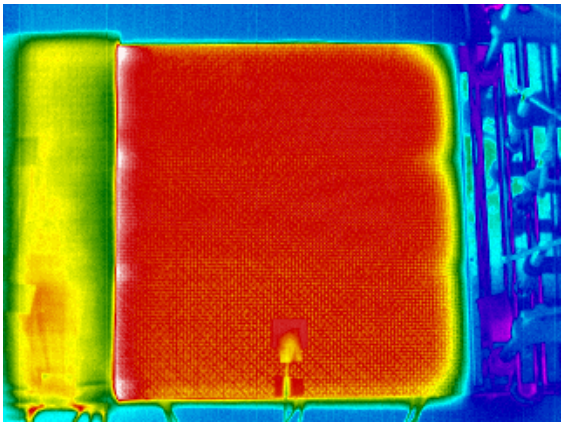
A full scale unit, including a high reliability deployment mechanism is currently under development.

Contact TMT to see how Thermally Efficient Deployable Radiators can be implemented into your next design

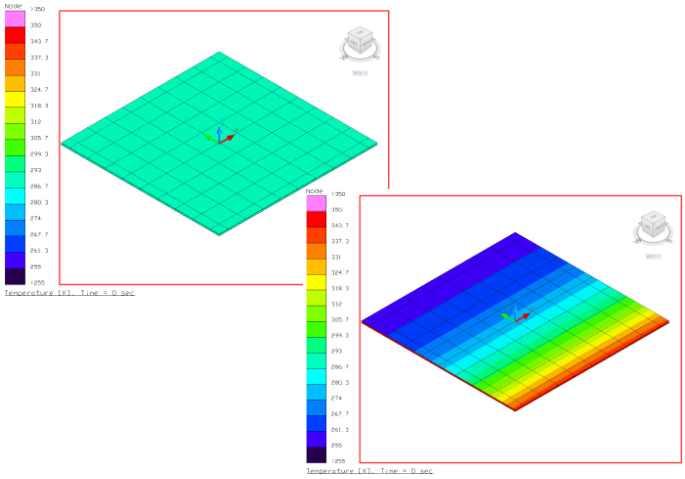
Deployable Radiators Can Be Configured for Your Application

Radiator Interfaces

- Radiator hinge to spacecraft interface
    - Thru holes for fasteners
    - Custom interfaces available
- Deployment Actuator
    - TBD – Under Development



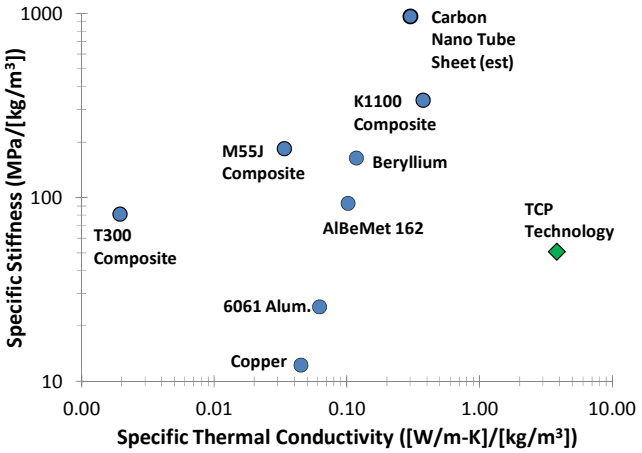
IR picture of 30.5 cm x 35.6 cm composite skin panel under test (~1C across active panel w/ 60 W input)



100 W radiator analysis comparison shown on same scale: Top: TMT radiator panel; Bottom: 0.5 cm aluminum plate

Key Specifications

- Operating temperature: -30 to +65 °C
- Survival temperature -40 to +75 °C
- Typical Uniformity
    - Radiator < 0.1 °C/W*m (length)
- Thermal Resistance across hinge
    - R_{hinge} < 0.09 °C/W
- Mass:
    - Typical radiator application: <8 kg/m^2
- Design Loads: (all axes)
    - 50 g
    - Random vibration 8.7 grms
- Typical thickness ~0.63 cm



Graph illustrates spacecraft material comparison showing significant improvement in thermal performance with Thermal Control Panel active thermal skins

** These values are for reference and should not be used for design*

Product History

This technology was developed under SBIR funding managed by AFRL Space Vehicles Directorate. Continuing SBIR development is being performed in cooperation with LoadPath.

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