

## Accepted Manuscript

Testing and Analysis of a Morphing Radiator Concept for Thermal Control of Crewed Space Vehicles

Christopher L. Bertagne, Thomas J. Cognata, Rubik B. Sheth, Craig E. Dinsmore, Darren J. Hartl

PII: S1359-4311(16)33835-2  
DOI: <http://dx.doi.org/10.1016/j.applthermaleng.2017.06.062>  
Reference: ATE 10581

To appear in: *Applied Thermal Engineering*

Received Date: 2 December 2016  
Revised Date: 14 May 2017  
Accepted Date: 11 June 2017

Please cite this article as: C.L. Bertagne, T.J. Cognata, R.B. Sheth, C.E. Dinsmore, D.J. Hartl, Testing and Analysis of a Morphing Radiator Concept for Thermal Control of Crewed Space Vehicles, *Applied Thermal Engineering* (2017), doi: <http://dx.doi.org/10.1016/j.applthermaleng.2017.06.062>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



# Testing and Analysis of a Morphing Radiator Concept for Thermal Control of Crewed Space Vehicles

Christopher L. Bertagne<sup>a</sup>, Thomas J. Cognata<sup>b</sup>, Rubik B. Sheth<sup>c</sup>, Craig E. Dinsmore<sup>c</sup>,  
Darren J. Hartl<sup>\*a</sup>

<sup>a</sup>Department of Aerospace Engineering, Texas A&M University, College Station, TX 77843

<sup>b</sup>Paragon Space Development Corporation, Houston, TX 77058

<sup>c</sup>Crew and Thermal Systems Division, NASA Johnson Space Center, Houston, Texas, 77058

## Abstract

Spacecraft designed for future missions must satisfy increasingly difficult thermal requirements. Crewed vehicles, in particular, must maintain a relatively constant temperature irrespective of external conditions; this is the role of the thermal control system (TCS). A TCS may be required to reject a higher heat load to warm environments and a lower heat load to cold environments, necessitating a high turndown ratio, often on the order of 12:1. This work presents a novel radiator concept that employs shape memory alloys (SMAs) to geometrically reconfigure the radiator, enabling a lighter TCS for space exploration vehicles. The thermally-driven morphing effect allows passive (i.e. non-controlled, non-powered) control of both radiator view of space and primary surface emissivity. Thermal and radiation modeling of the morphing radiator predict a turndown ranging from 12:1 to 35:1 independent of the other aspects of TCS configuration. A system-level mass analysis shows that by enabling a single-loop architecture, this design could reduce the TCS mass by approximately 25%. Two benchtop prototypes provide proof-of-concept demonstrations of the radiator's principles of operation. Additionally, an analysis framework is developed for the first time that is capable of simulating the unique and highly nonlinear thermomechanical coupling present in the radiator. The framework provides high-fidelity results of both the stress in the radiator as well as its thermal behavior.

Keywords: radiators, thermal control, spacecraft, shape memory alloys

---

\*Corresponding author: darren.hartl@tamu.edu

Download English Version:

<https://daneshyari.com/en/article/4990680>

Download Persian Version:

<https://daneshyari.com/article/4990680>

[Daneshyari.com](https://daneshyari.com)