National Aeronautics and Space Administration

DEVELOPMENT OF DESIGN AND PRODUCTION PROCESSES FOR BLOCK-ABLATOR HEATSHIELDS WITH PRELIMINARY TEST RESULTS

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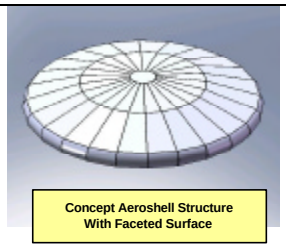
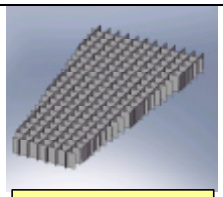
Abstract - The block-ablator concept is based on the milling of high-tolerance ablator blocks and the subsequent adhesive installation of these blocks into precision honeycomb already pre-bonded to an aeroshell structure. Intended for use on atmospheric entry, descent, and landing (EDL) vehicles, the concept originated at NASA's Ames Research Center in 2006-07. The Ablatives Laboratory (ABL) was tasked by NASA to mature the concept by developing a producible B-A design and by investigating and developing production processes for a B-A heatshield system. The ABL performed this preliminary one-year study during 2008-09. This poster summarizes the ABL's selected B-A design (shown below) that is based on trapezoidal-shaped blocks and H/C cells made of silica-phenolic composite. Although not comprehensive, our IPPW-7 paper discusses production processes, and primary lessons learned from the fabrication of multiple test units and manufacturing demonstration units.

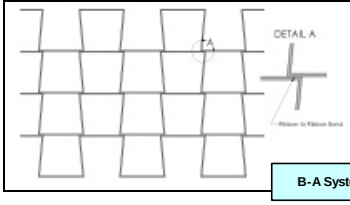


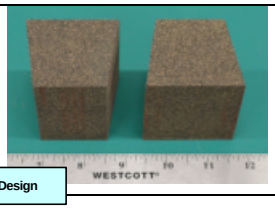
Concept Aeroshell Structure With Faceted Surface



Concept Honeycomb For Large Gore Regions

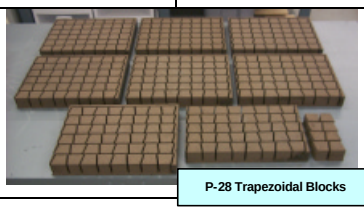
Concept Ablator Block With Square Shape



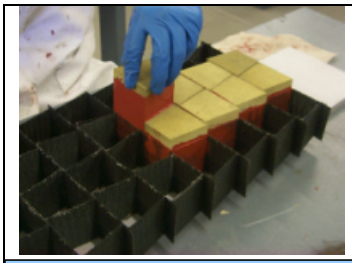


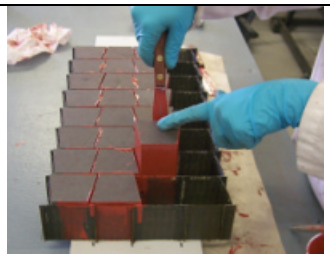
B-A System Design

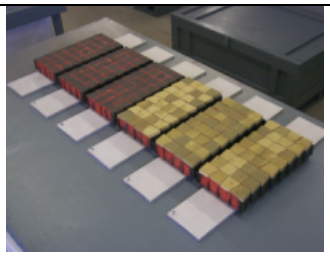
Trapezoidal Honeycomb
144 Cells Per Panel
2.00 / 2.75-In. Tall

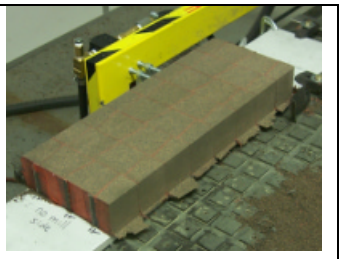


P-28 Trapezoidal Blocks

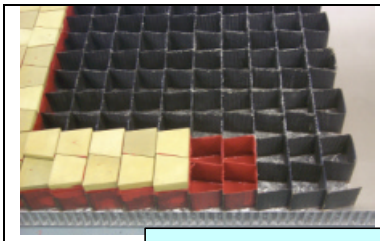


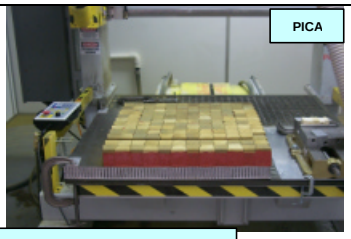




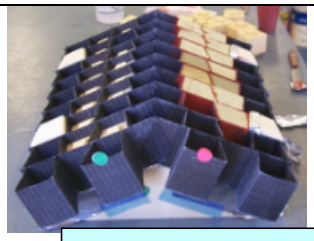


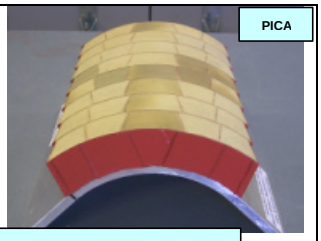
Producing Flexure Test Samples from PICA and PhenCarb-28 Blocks: 1) Bond B-A Honeycomb to Structure; 2) Bond Ablator Blocks into Cells; 3) Mill Sample to Final Dimensions.



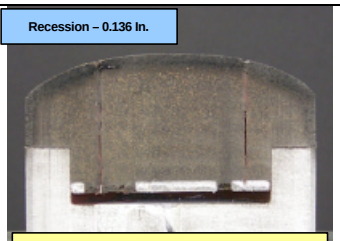


Manufacturing Demonstration of B-A Flat Panel 24 x 24 In.



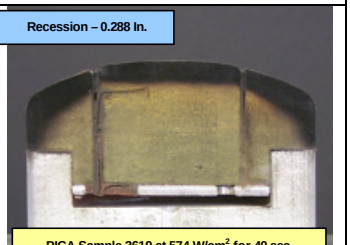


Manufacturing Demonstration of B-A Curved Shoulder Panel



Recession – 0.136 In.

P-28 Sample 3606 at 574 W/cm^2 for 40 sec.



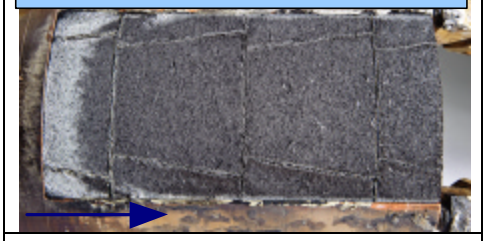
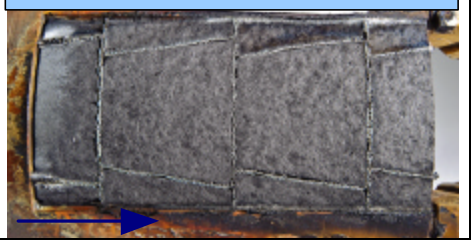
Recession – 0.288 In.

PICA Sample 3619 at 574 W/cm^2 for 40 sec.

Arc-Jet Testing B-A Samples

Both stagnation and aeroshear tests were conducted in 2009. P-28 Sample 3606 and PICA Sample 3619 were tested at 574 W/cm^2 at 0.290 atm. Test results are shown on the left. (Other samples were tested at 958 W/cm^2 and 620 W/cm^2 in addition to those shown.) Both ablators performed well in the B-A configuration showing basically no difference compared to their known monolithic behavior (for shape change, surface recession and temperature response). Test results are shown on the right for samples tested in aeroshear. These are P-28 Sample 3706 and PICA Sample 3719 tested at 261 W/cm^2 and 8.89 lb/ft^2 shear. Of major importance was the very good performance of the B-A seams, which remained tightly closed. Seam composite material receded at the same rate as the ablator, thus preventing flow interference heating effects.

P-28 Sample 3706 – 261 W/cm^2 for 25 sec – 8.89 lb/ft^2 – 0.247 atm



PICA Sample 3719 – 261 W/cm^2 for 25 sec – 8.89 lb/ft^2 – 0.247 atm