Arc Jet Test and Analysis of Asbestos Free Solid Rocket Motor Nozzle Dome Ablative Materials

J. Louie Clayton

Asbestos free solid motor internal insulation samples were recently tested at the MSFC Hyperthermal Arc Jet Facility. Objectives of the test were to gather data for solid rocket motor analog characterization of ablative and in-depth thermal performance of rubber materials subject to high enthalpy/pressure flow conditions. Tests were conducted over a range of convective heat fluxes for both inert and chemically reactive sub-sonic free stream gas flow. Active instrumentation included use of total calorimeters, in-depth thermocouples, and a surface pyrometer for in-situ surface temperature measurement. Post-test sample forensics involved determination of eroded depth, charred depth, total sample weight loss, and documentation of the general condition of the eroded profile. A complete Charring Material Ablator (CMA) style aero thermal analysis was conducted for the test matrix and results compared to the measured data. In general, comparisons were possible for a number of the cases and the results show a limited predictive ability to model accurately both the ablative response and the in-depth temperature profiles. Lessons learned and modeling recommendations are made regarding future testing and modeling improvements that will increase understanding of the basic chemistry/physics associated with the complicated material ablation process of rubber materials.

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