METHODOLOGY FOR SIMULTANEOUS SIMULATION OF CONVECTIVE ANDRADIATIVE HEATING

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Abstract

During the ascent flight of a Launch Vehicle (LV), certain regions are exposed to radiative and convective heating simultaneously. A typical example is the flexible multilayer thermal barrier for launch vehicle base region which experiences both radiative heating from the plume and hot nozzle divergent as well as convective heating due to reverse flow. To design and evaluate the effectiveness of the thermal barrier, simultaneous simulation of both radiative and convective heating is essential. This was made possible by the utilization of controlled radiant heaters and a Convective Heating System (CHS), both acting simultaneously in a pre-designated sequence. Such a simulation is very challenging since, the simultaneous simulation of radiative heating and convective heating mutually interferes with their respective independent control systems. Besides, the influence of the boundary conditions in the heat transfer process is different for radiative and convective heating. Hence, a novel technique was adopted to isolate the respective control systems. Detailed tests were undertaken to map the flow field at various distances from the exit to determine the position of the test article. After extensive mapping, the facility was utilized for simulations of both radiative and convective heating simultaneously on a thermal protection element in the launch vehicle base region, which experiences simultaneous simulation of convective and radiative heating. The studies were able to bring out the effect of hot gas permeability and thermal response and ascertain that the back wall temperatures are within allowable temperature constraint. This mode of simulation is a new technique where both simultaneous simulation of convection and radiation was undertaken to simulate the actual environments of flight on a specific system

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