TEMPERATURE VARIATION OF RADIANT HEATER MODULES USED FOR RE-ENTRY HEATING SIMULATIONS

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Abstract

Launch Vehicles/Spacecrafts are thermally protected from ascent/reentry flight aero heating using different types of thermal protection systems (TPS) that are selected based on the maximum heat flux and total heat load. The TPS is designed/qualified by simulating the actual heat flux history on test samples. The heat flux history can be simulated on the test panels using radiant heater modules which are dynamic, fast response and actively controllable. During heat flux simulation, the actual heat absorbed by the material depends on the surface absorptivity of the exposed surface to the heating. The effective surface absorptivity is derived from the absorptivity spectrum using the emission spectrum of the heating filament at its source temperature. Hence it is important to estimate the filament temperature for a given heat flux simulation in order to determine the effective surface absorptivity. This is essential for accurately determining the actual heat flux absorbed by the material and thereby attaining the correct material thermal response. The radiant heater module used in this study consists of tungsten filaments enclosed in argon filled quartz bulbs. Calculation of the filament temperature and quartz tube temperature is done by solving the energy balance equation of both filament and quartz tube. For the filament, power input is the product of voltage and current, which can be experimentally measured. Properties like emissivity of filament, conductivity of argon as a function of temperature is incorporated in the model, theoretical modelling of heat transfer and filament temperatures have been undertaken elsewhere, but details of estimation of filament temperature with respect to the simulated heat flux and distance from lamp module for high power rated 8kW filaments used in re-entry aero thermal simulations are not available. This work describes the estimation of the filament temperature variation as a function of heat flux and distance from the heater module utilizing actual measurement of current and voltage through each filament.

Keywords : *Filament temperature, Heat flux, Radiant heaters*

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