Aerothermal

Aerothermal involves the aerothermodynamic coupling with spacecraft surface chemistry. Key areas within this field are plume heating, aerodynamic heating, on-orbit contamination, and free molecular heat transfer. This includes analysis, design, and testing for space and aeronautics.

Plume heating occurs when a vehicle is immersed in rocket nozzle exhaust plumes. These can be either atmospheric or on-orbit effects.

Aerodynamic heating results from the flow of gas over a spacecraft. The convection causes an additional heat load to what occurs through system heat dissipation and environmental radiation. At supersonic speeds, the temperature impact is such that material performance limits can be impacted. Studies to quantify and control aerodynamic heating include wind tunnel testing, numerical simulations, or flight testing. Aerodynamic heating is of interest in all aspects of flight: ascent, on-orbit, and entry.

On-orbit contamination results in the degradation of spacecraft surfaces in orbit due to the deposition of contaminants. This is caused by a variety of events including outgassing, venting, leaking, and thruster firings. Surface properties may be altered. In certain circumstances, the onset of electrostatic discharge can occur.

Free molecular heat transfer (FMHT) is heat transfer that occurs to spacecraft at high altitudes. Intermolecular collisions in this regime are low as defined by the Knudsen number. The Knudsen number describes the molecules mean free path with respect to the characteristic length scale. In general, free molecular heat transfer occurs at a Knudsen number greater than 10.