INVESTIGATION OF VELOCITY GRADIENT IN PLANETARY RE-ENTRY CONDITIONS SIMULATED IN THE VKI PLASMATRON

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When spacecraft return to Earth from any of their mission they undergo severe heat loads that can seriously damage them or their Thermal Protection Systems. In order to accurately calculate this value of the heat flux, a determination of the curvilinear velocity gradient simulated in subsonic high enthalpy conditions is needed (as it can be tested in the VKI Plasmatron).

A methodology developed at the Institute for Problems in Mechanics in Moscow has assessed the local simulation of the flowfield around an aerospace vehicle nose in ground test facilities.

A multipressure probe designed for testing at high enthalpy conditions has been used to obtain the stagnation point velocity gradient extracted from the pressure distribution around the probe (Figure 1). Measurements in a subsonic wind tunnel and numerical simulations of different blunt probe geometries helped with the design (Figure 2).

Results from the pressure gradient are in accordance with already performed Pitot measurements. Acceptable experimental values of the stagnation point velocity gradient were obtained from the measurements. Its order of magnitude was within 5000 s^{-1}. Numerical computations reveal similar results. A new experimental setup with the objective of reduce pressure response times was used with success.

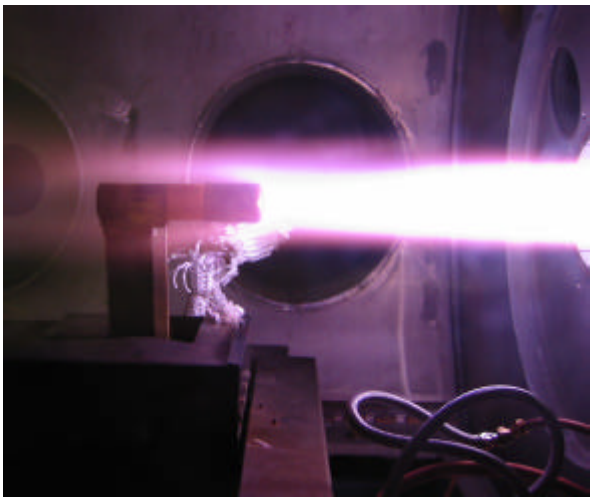

Figure 1: Multipressure probe tested in the Plasmatron

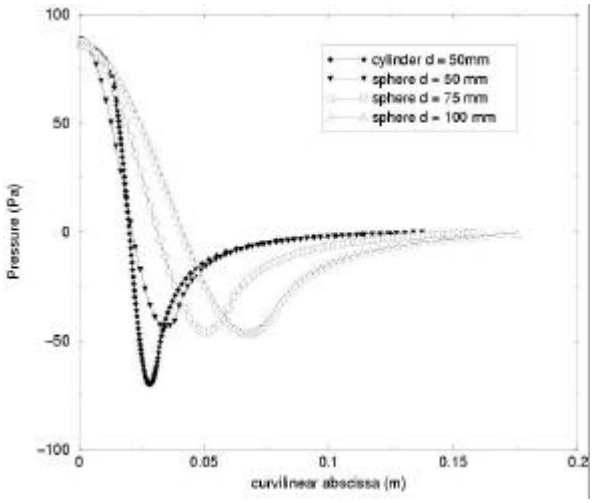

Figure 2: Computed pressure distributions for different probe geometries