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Thermal Loads on a Domed Protuberance Under a Mach 5.7 Boundary Layer[1] CHRISTOPHER OSTOICH, DANIEL BODONY, PHILIPPE GEUBELLE, University of Illinois at Urbana-Champaign — A high-fidelity, high-accuracy multi-physics computational tool has been developed to make predictions of structural-thermal response in the hypersonic regime. The predicted surface heat flux distribution was compared with measured data taken from a 1986 experiment in the NASA Langley 8-foot high-temperature tunnel in which a flat plate with a domed protuberance was inserted into a Mach 6.59 flow. The solution from the fluid and thermal domains obtained from the coupled simulation, with experimental comparisons, will be presented. In addition to the typical heating associated with windward-facing surfaces, several other sources of significant differential heating were observed near the dome-plate interface and due to a trailing horseshoe vortex of small size. Data were collected over a long time record (50 seconds) and comments will be given about ignoring transient thermal effects in hypersonic boundary layer calculations. An assessment of gas thermal model assumptions will also be discussed.

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