

# Accepted Manuscript

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PII: S0094-5765(17)31334-6

DOI: [10.1016/j.actaastro.2018.01.011](https://doi.org/10.1016/j.actaastro.2018.01.011)

Reference: AA 6640

To appear in: *Acta Astronautica*

Received Date: 26 September 2017

Revised Date: 30 November 2017

Accepted Date: 4 January 2018

Please cite this article as: K.J. Irimpan, V. Menezes, Effect of surface roughness on the heating rates of large-angled hypersonic blunt cones, *Acta Astronautica* (2018), doi: 10.1016/j.actaastro.2018.01.011.

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## Effect of surface roughness on the heating rates of large-angled hypersonic blunt cones

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### ABSTRACT

Surface-roughness caused by the residue of an ablative Thermal Protection System (TPS) can alter the turbulence level and surface heating rates on a hypersonic re-entry capsule. Large-scale surface-roughness that could represent an ablated TPS, was introduced over the forebody of a  $120^\circ$  apex angle blunt cone, in order to test for its influence on surface heating rates in a hypersonic freestream of Mach 8.8. The surface heat transfer rates measured on smooth and roughened models under the same freestream conditions were compared. The hypersonic flow-fields of the smooth and rough-surfaced models were visualized to analyse the flow physics. Qualitative numerical simulations and pressure measurements were carried out to have an insight into the high-speed flow physics. Experimental observations under moderate Reynolds numbers indicated a delayed transition and an overall reduction of 17 to 46% in surface heating rates on the roughened model.

**Keywords:** Re-entry, Hypersonic, TPS, Heat-transfer, Surface-roughness, Transition-delay.

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