EXPERIMENTAL STUDY OF SHOCK-WAVE BOUNDARY LAYER INTERACTION IN THE LONGSHOT WIND TUNNEL

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For the Future Launch Technology Program of ESA a study of shock-wave boundary layer interaction was performed on a blunted double cone. This test article replicates the critical design points of heat loads and the pressure distribution on body flaps of re-entry vehicles. One objective of the investigation was to determine whether transitional flow at reattachment would give a higher heat load than the turbulent level. To evaluate this an attempt was made to obtain laminar, turbulent and transitional flow at reattachment on the model in the VKI Longshot Wind Tunnel. In addition, the effect of γ was investigated by using two different test gases, nitrogen and carbon dioxide.

For nitrogen the resulting heat flux is shown in the figure, together with a Schlieren image. Turbulent, laminar and transitional flow at reattachment were observed. For carbon dioxide only the laminar and turbulent case were obtained. Furthermore the transitional case with nitrogen did not show peak heating higher than the turbulent level. By performing additional data reduction at different times in the useful measurement period of approximately 20 ms, this preliminary conclusion will be investigated further.

Numerical simulations of the flow over the double cone for one of the nitrogen flow test conditions were also performed. However, an inadvertent alignment of the grid with the bow shock appears to have caused a 25 % difference between numerical and experimental results for the pressure and the heat flux.

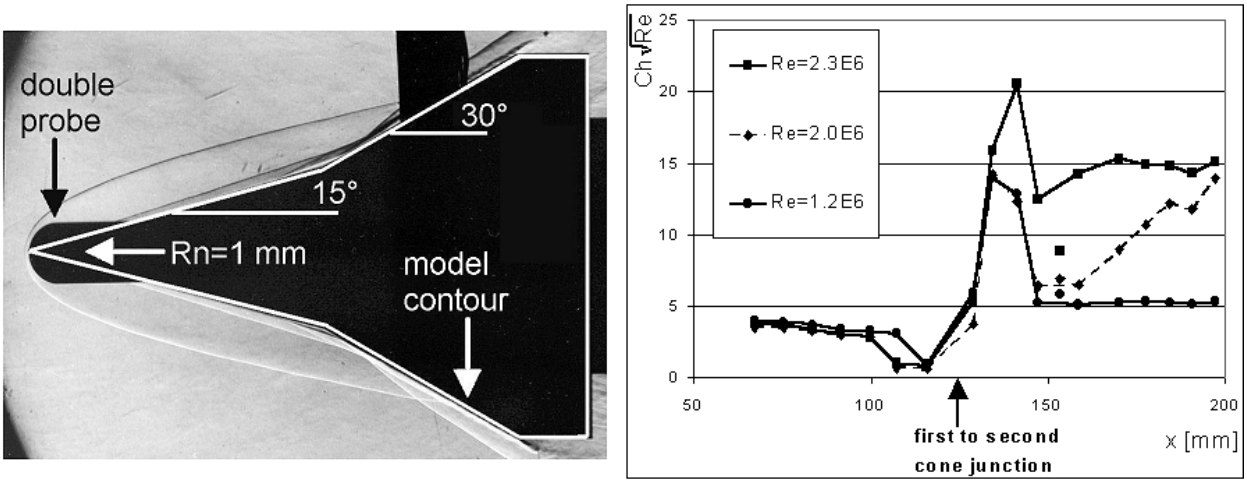

Figure1: Schlieren image for nitrogen (Re=) and heat flux on the wall (modified Stanton number times the square root of the Reynolds number based on the model length of 231 mm)