AERO-THERMAL EFFECTS OF FILM COOLING ON A SQUEALER TIP OF A GAS TURBINE BLADE

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Tip leakage flows cause high aerodynamic losses and heat transfer rates on turbine blades. Tip leakage losses can be as high as one third of the total losses. Moreover, high heat transfer rates lead to catastrophic failures of turbines. Today, in order to reduce the effect of tip leakage flow, recessed type tips, which are known as squealer type tips, are used with film cooling.

The aim of this project is to investigate the effect of film cooling on the squealer tip of a gas turbine blade in a high speed environment. For this purpose, a model blade was constructed and instrumented (Figure 1).

Experiments were performed in the CT-2 VKI short duration compression tube facility. Pressure measurements were obtained for an exit Reynolds number of 900,000 and an exit isentropic Mach number of 0.9. Film cooling was applied for four different blowing ratios at ambient coolant temperature. Detailed results were obtained within the squealer, along its inner and outer rims and on the opposite endwall.

Heat transfer measurements were performed with the help of fast response double layer thin film gauges installed on the squealer surface. The data were acquired for two exit Reynolds numbers of 450,000 and 900,000 and two turbulence intensity levels of 1 % and 3.5 %. The exit Mach number was the same as for the pressure measurements. The film cooled heat transfer investigation was performed for two coolant temperatures. Different blowing ratios were investigated.

The effect of coolant conditions was clearly put in evidence by comparing the results with the uncooled configuration. The resulting detailed data base can be used for code validation.

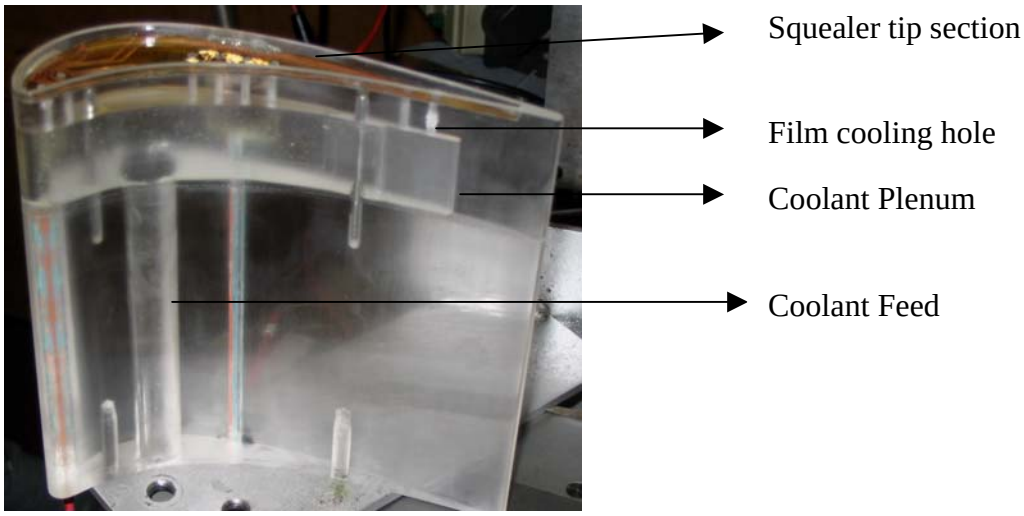

Figure 1 Instrumented Blade for Heat Transfer Measurements