Secondary Flow Measurement of an Outlet Guide Vane Cascade at Low and High Inlet Turbulence Intensities

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The aim of this project is to investigate the secondary flow pattern downstream of a low pressure turbine/outlet guide vane (LPT/OGV) cascade. These vanes are found downstream of the low pressure turbine in turbojet engines, and are responsible for turning the inlet swirling flow from the low pressure turbine into an axial outflow, whilst minimising pressure losses. This is of prime importance with both cost and weight being reduced in modern turbojets resulting in a reduced amount of stages in the LPT which in turn increases the loading on the OGV's.

The experiments were carried out at Chalmers in Sweden, using a low speed linear cascade. This paper presents the experimental results carried out using a cross wire probe at various downstream positions at 30 degrees inlet flow angle, which is the on-design point. Both low and high turbulence intensity cases have been investigated at one Reynolds number. As shown in figures 1a and 1b, the main characteristics of the flow include the passage vortex, the trailing edge vortex sheet and the boundary layer on the sidewall. The results also show the interaction of these structures and how they evolve as they move downstream. The effect of increased turbulence will be seen to play an important role in the diffusion of the vortical structures as well as their interactions. These findings are then related to the main flow characteristics, including velocity, pitch angle, losses, turbulence intensity and Reynolds stresses. This will result in an understanding of the significance of the secondary flows and how they affect the efficiency of turning the flow. The results from the cross wire probe will also be compared to those obtained from an earlier investigation using a five hole probe.

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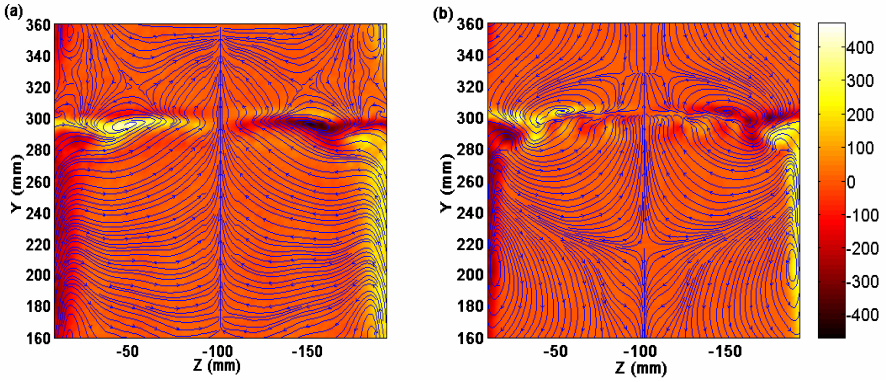

Figure 1: Streamwise vorticity distribution with superimposed streamlines in yz plane downstream of the mid vane of the cascade (a) at 5% turbulence intensity (Tu) and (b) at 0.5% Tu.