

Effect of Tip Clearance on Loss and Three-Dimensional Flow of a Turbine Cascade Part 2: Increase in Free-Stream Turbulence Intensity

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1. Introduction

The loss of performance due to tip clearance flow has been intensively studied for many years. This two-part paper describes the effect of tip clearance on the aerodynamics of a turbine cascade at very low Reynolds numbers: $Re_{out}=4.4\times 10^4 \sim 26.6\times 10^4$. The free-stream turbulence intensity varied between 0.5% and 4.1%. Three-dimensional flow fields at the turbine exit were measured using a five-hole pressure probe for both “with tip clearance” and “without tip clearance” cases. Part 2 of the paper investigates the effect of increased free-stream turbulence intensity.

2. Results and conclusions

Figure 1 shows the distributions of the total pressure loss at the turbine exit. The high loss region of the tip clearance flow at higher turbulence intensity was concentrated in the tip region. Mass-averaged

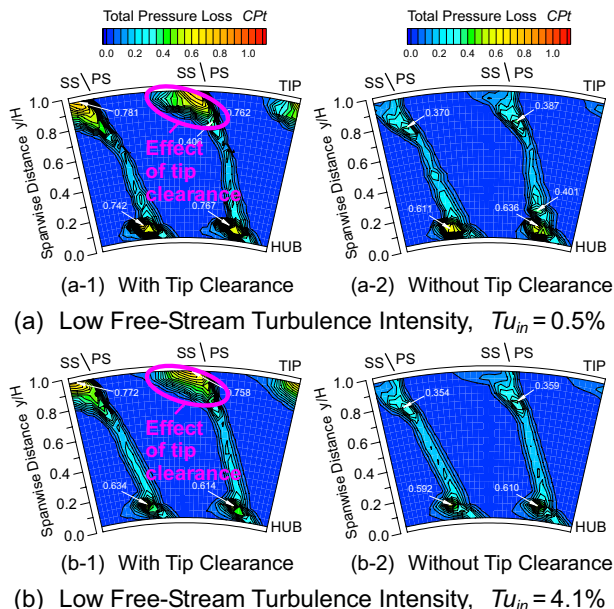


Fig. 1 Effect of free-stream turbulence intensity on total pressure loss distributions at exit of turbine cascade ($Re_{out}=13.3\times 10^4$)

exit loss and tip clearance loss are shown in Figures 2 and 3. The exit loss and tip clearance loss remained nearly constant at the various free-stream turbulence intensities. The turbulence intensity had an almost negligible effect compared with the Reynolds number.

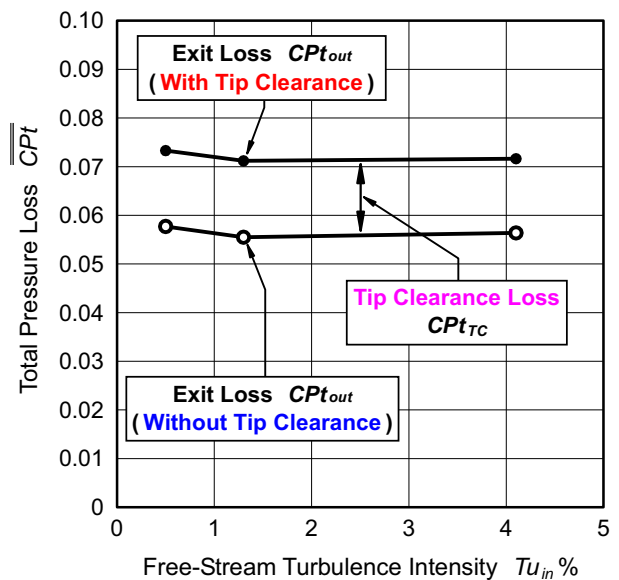


Fig. 2 Measured mass-averaged total pressure loss at turbine cascade exit

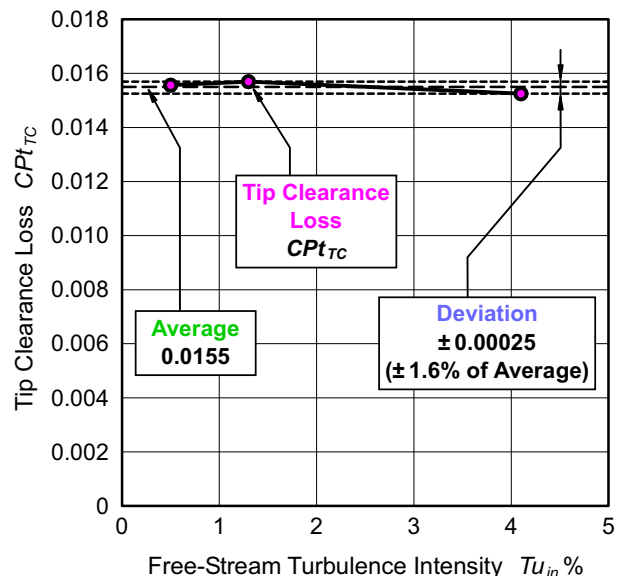


Fig. 3 Measured tip clearance loss

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