Effect of Tip Clearance on Loss and Three-Dimensional Flow of a Turbine Cascade Part 1: Decrease in Reynolds Number

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1. Introduction

Tip clearance losses represent a major efficiency penalty in turbine blades. This two-part paper describes the effect of tip clearance on the aerodynamic characteristics of a turbine cascade under very low Reynolds number conditions, Re_{out}=4.4×10⁴ ~ 26.6×10⁴. Three-dimensional flow fields at the exit of the turbine cascade were measured using a five-hole pressure probe for both "with tip clearance" and "without tip clearance" cases. Part 1 of the paper investigates the effect of decreased Reynolds number.

2. Results and conclusions

Figure 1 shows the distributions of the total pressure loss at the turbine exit. The high loss region due to the tip clearance flow at lower Reynolds number spread a wide area. Mass-averaged exit loss and tip clearance loss are shown in Figures 2 and 3, respectively. Although the exit loss increased dramatically with the decreasing Reynolds number, the tip clearance loss remained almost constant at a range of Reynolds numbers. Therefore, Reynolds number had insignificant effect on the tip clearance loss.

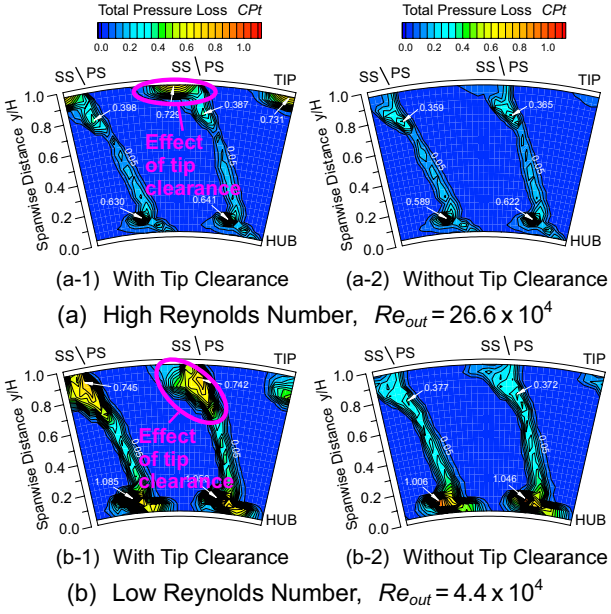

Fig. 1 Effect of Reynolds number on total pressure loss distributions at exit of turbine cascade (free-stream turbulence intensity Tu_{in}=0.5%)

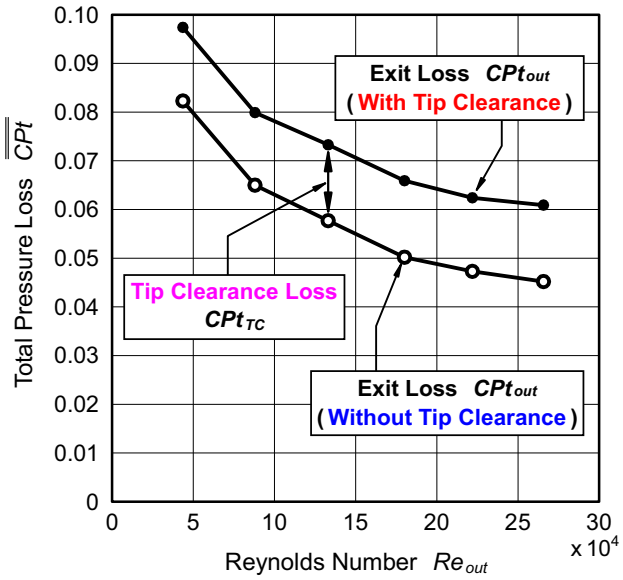

Fig. 2 Measured mass-averaged total pressure loss at turbine cascade exit

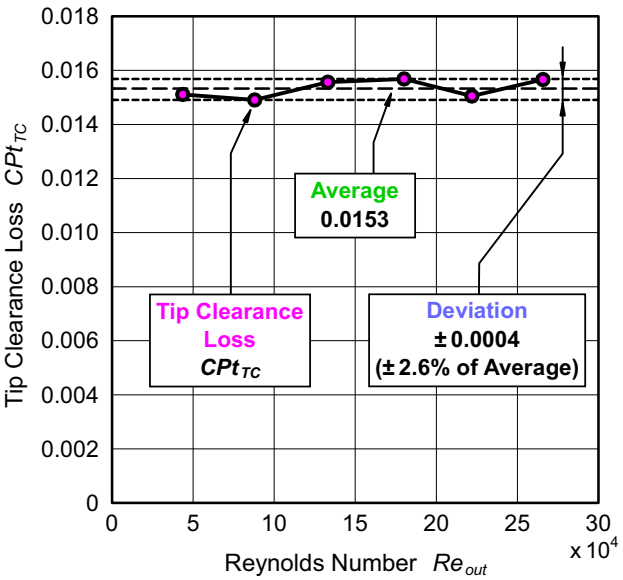

Fig. 3 Measured tip clearance loss

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