

EXPERIMENTAL STUDY OF THE SEAL LEAKAGE FLOW IN AN AXIAL COMPRESSOR STAGE

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This study was focused on the problem of seal leakage flow at the stator hub in a compressor stage. Over the years experience has confirmed that shrouded stator cavity flows have a significant effect on the performance of multistage compressors because of the reingestion into the main stream of the recirculated high pressure flow through the labyrinth seals underneath every stator blade row. A shroud at the hub of the airfoil provides mechanical stability and eliminates the clearance leakage; however leakage can occur from downstream to upstream of the blade row through the seal/seal tooth gap. The pressure difference across the stator determines the leakage mass flow rate. It is very difficult to predict the exact leakage mass flow because of the uncertainty of the exact radial clearance of the labyrinth seal in operation. Therefore, the value of the mass flow in the seal cavity must be obtained experimentally by means of measurements of pressures and temperatures in the different cavity areas across the labyrinth seal. The experiments were carried out in the VKI high speed compressor test rig R-4.

The study was composed of three main phases: a calibration phase, to determine the pressure loss characteristic of the complete seal cavity as a function of a known injected mass flow, a measurement phase, to determine the mass flow in the natural leakage configuration and the effects of seal leakage flow phase determination of the seal leakage effects on the main flow.

Detailed flow field measurements, both at rotor and stage exit were performed for 3 different seal leakage mass flow rates. It was seen that by the increase of the seal leakage flow hub corner separation on the suction side of the blade is increasing. And also the increase in the seal leakage flow rate causes increase in the incidence, deviation and the blockage at the hub.

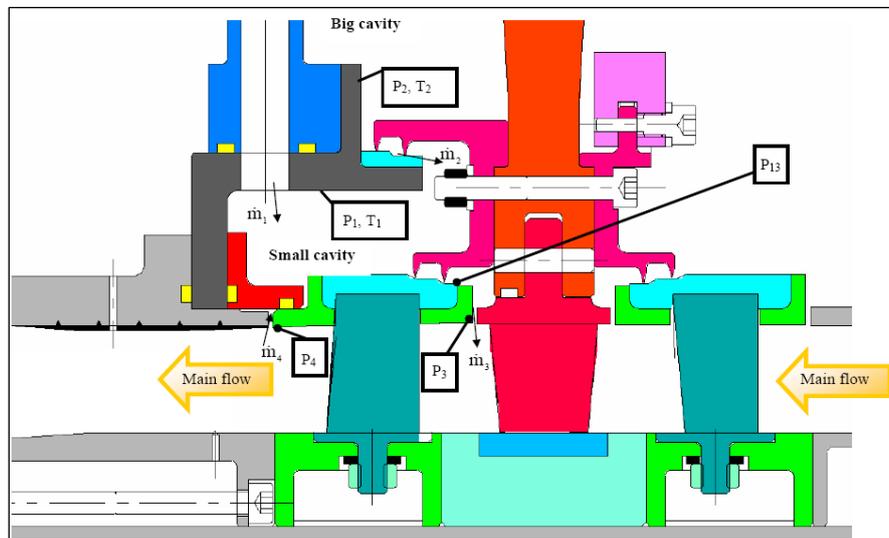


Figure 1: Sketch of the seal cavity and leakage flow