

SOME STUDIES ON FLOW THROUGH RADIAL VANED DIFFUSERS

by

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CERTIFICATE

This is to certify that the thesis entitled 'SOME STUDIES ON FLOW THROUGH RADIAL VANED DIFFUSERS' by Dev Prakash Agrawal has been prepared under my supervision in conformity with the rules and regulations of the Indian Institute of Technology, Delhi. I further certify that the thesis has attained a standard required for a Ph.D. degree of the Institute. The results contained in this thesis have not been submitted, in part or full, to any other university for any degree or diploma.

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ABSTRACT

The outgoing kinetic energy from an impeller is converted into pressure energy in diffusers. Radial vaned diffusers achieve large conversion at high peak efficiency and are used in applications where overall size of the machine is of utmost importance. In this report, results of some studies on flow through radial flat vaned diffusers have been presented. The important parameters affecting the performance were identified through a review of the existing literature. The need for producing experimental data on a radial flat vaned diffuser was realized and subsequently an experimental programme was undertaken.

The experimental programme was concerned with data collection in terms of velocity and flow angle profiles, blade and wall static pressure distributions and calculations of static pressure recovery and stagnation pressure loss coefficients from blade-to-blade traverses. For this, a large size test rig was designed and fabricated. The swirl at diffuser inlet was generated by a double wire gauze rotor. The diffuser blades were flat plates and their leading edges were kept 4 cm downstream of the gauze rotor. Five diffusers were obtained by varying the leading edge angle between 10° to 40° from circumferential direction.

A 3-hole tube probe was supported on a versatile traversing gear for traversing in the flow. Static pressures on blade and wall surfaces were measured by static pressure taps. The experiments covered an area ratio range of 1.0 to 8.0 for various values of incidence (-25° to $+30^{\circ}$) and Reynolds number (0.75×10^5 to 1.95×10^5).

The data obtained from the tests were analysed and presented in graphical form. A maximum value CPR of about 0.59 was obtained. Diffusers with lesser leading edge angle showed poorer performance than the other diffusers. For these diffusers it was found that the vaneless and semi-vaneless space upstream of throat affected the performance considerably.

All diffusers showed stall patches, the diffusers V-10 and V-15 showing permanent stall. The presence of stall depended heavily on incidence and Reynolds number values. Presence of secondary flows at the middle of the channel was observed for some diffusers.

From experimental results, it was concluded that incidence, area ratio and throat opening have a strong effect on diffuser performance.

In the analytical study, simplified form of the 2-Dimensional equation of motion (Laplace's equation) was solved using both singularity and finite-difference techniques, to

predict blade-to-blade velocity profiles. The computed results were compared with experimental measurements and showed fair similarity. The results from experiments were also compared with the existing data and correlations.

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