

ANALYSIS OF FLOW THROUGH VOLUTE  
CASINGS OF CENTRIFUGAL MACHINES

by

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Submitted

in fulfilment of the requirements of  
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to the

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To  
my parents

CERTIFICATE

This is to certify that the thesis entitled ''Analysis of Flow Through Volute Casings of Centrifugal Machines'' being submitted by Ramashish Yadav for the award of the degree of 'Doctor of Philosophy' to the Indian Institute of Technology, Delhi is a record of bonafide research work he has done during November 1974 to November 1977 under my supervision. The results obtained in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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## ABSTRACT

The present work was undertaken to study theoretically and experimentally the internal flow behaviour in volute casings of centrifugal blowers and compressors with standard swirling flow free from jets and wakes at its inlet for wide range of throat length to volute inlet diameter ratio, tongue position, swirl angle and Reynolds number.

In theoretical part of the work, one dimensional flow model taking into account friction and mixing was formulated and solved for pressure distribution along the volutes. For prediction of velocity profiles in volutes, two dimensional ideal flow model had been formulated and the resulting equations were solved by singularity method. The well known free-vortex analysis was also used just to compare experimental findings of velocity profiles.

In the experimental part of the work, a new method for testing the volutes was developed. Present test rig consists of an air supply unit, swirl generator and the volute casing. The air was fed to the volutes by a centrifugal blower (driven at 3000 rpm by 30 H.P. A.C. motor) through a transition piece, a settling chamber and a swirl generator. The swirl generator used works on the principle of free vortex flow. It consisted of 24 number of nozzle

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blades. The volute was designed using the principle of constant mean velocity and was fabricated from devdar sleeper and commercial plywood. Such six volutes were fabricated

The tests on the volutes were conducted at six Reynolds numbers (ranging from  $3.75 \times 10^5$  to  $13.125 \times 10^5$ ) and five inlet swirl angles (ranging from  $10^\circ$  to  $35^\circ$ ) in each of six volutes. Measurements of stagnation pressure, static pressure and flow direction were carried out along axial, radial and tangential directions with the help of 3 hole calibrated probe. Wall static pressure along radial and tangential direction were also measured with the help of wall tapings.

The volute performance was studied by plotting velocity, swirl angle, static pressure, total pressure distributions, pressure recovery and total pressure loss coefficients for various inlet flow conditions in all the six volutes.

Comparison of experimental findings and theoretical predictions shows good correspondence.

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