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Study of Flow Patterns in Vaneless Diffusers of Centrifugal Compressors using PIV

by

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ABSTRACT

In centrifugal compressors, rotating impellers give energy to fluid. And, diffusers are some of the main components for the pressure recovery function. Therefore, in order to improve their performance, it is important to understand the aspect of the flow field in diffusers in detail. However, such diffusers generally have very small widths. Due to the occurrence of adverse pressure gradients in diffusers, secondary flows are generated, making the flow fields more complicated. In addition, skewed boundary layers form on wall surfaces. It is also known that flow fields become more complicated, which leads to the generation of rotating stalls as flow rate reduces. For this reason, it is necessary to clear flow fields in order to better understand diffuser characteristics. In this study, PIV was used for measurement. Pressure was also measured using a semi-conductor pressure transducer to obtain data on static pressure fields.

This experiment was performed using an open loop centrifugal compressor without a scroll casing. The test rig used a parallel-wall diffuser with the following dimensions: width 0.017m; inlet diameter 0.345m; outlet diameter 0.862m. The impeller had the following dimensions: inlet width 0.032m; outlet width 0.017m; inlet diameter 0.16m; outlet diameter 0.345m. The corrected revolution of the impeller was kept at 2000rpm during the experiment. Flow rate was measured with a pressure transducer located at the inlet nozzle of the compressor and controlled by a butterfly valve.