Abstract

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A curved diffuser as the outlet system of a radial compressor is a key component for the proper operation of the compression stage with pipe diffuser. A properly designed outlet diffuser channel is crucial for the stability and efficiency of the entire radial compressor stage, as well as for the proper operation of the combustion chamber located behind the diffuser. The subject of the dissertation is the numerical and experimental analysis of the flow through a curved diffuser and the method of modifying the geometry of the diffuser channel in order to equalize the outlet velocity profile.

The work includes a review of the solutions used in the outlet systems of radial compressors in turbine engines, as well as a literature review of studies on curved diffuser. Thermo-gasdynamic calculations of the curved diffuser were performed, on the basis of which the geometry of the diffuser channel was determined. In order to perform experimental studies, a research methodology was developed by building a dedicated test stand with dedicated measuring equipment for this stand. The test stand was calibrated to determine the velocity and turbulence profile at the diffuser inlet. A series of tests of the pressure distribution on the walls of the diffuser channel and at its outlet were performed, determining the outlet velocity field from the curved diffuser channel.

The author built a simulation model of the diffuser and conducted flow simulation through the diffuser in the AnsysFluent environment for real inlet boundary conditions, implemented from experimental studies. With the numerical results available, validation of the obtained results was performed through experimental results to confirm the correctness of the modeled numerical diffuser model. In the final step, the author optimized the geometry of the diffuser channel using a adjoint solver to equalize the outlet profile from the curved diffuser duct.