

ABSTRACT

The accuracy of computer codes for turbo machinery flow field calculations is strongly reliant on the type and behavior of the turbulence model used in the computations. Therefore, the validation of these codes is inherently dependent on results from experimental data. The effect of several turbulent models based on the isotropic eddy viscosity concept and Reynolds Averaged Navier Stokes (RANS) modeling approach were tested to investigate the flow field characteristic of a two dimensional cascade blade. The cascade blade is a first stage rotor of the high pressure (HP) turbine of the F-100-PW-220 military turbofan used to drive the F-16 aircraft.

Numerical simulations were performed on an irregular quadratic structured grid with the FLUENT (V6.3) software package which solves the Navier–Stokes equations by using finite volume methods. Two-dimensional stationary numerical simulations were made under turbulent conditions allow to compare the effect of flow characteristics through the cascade blade passage. Many numerical simulations were made to investigate different turbulence models: a one equation model, such as (Spalart-Allmaras) and several two-equation models, such as (S k- ϵ , RNG k- ϵ , Realizable k- ϵ and S k- ω and SST k- ω).

The experimental work was introduced to validate the numerical solutions. This was done by manufacturing five linear cascade blades tested in an open jet type low speed subsonic wind tunnel, for Reynolds number ($Re = 2 \cdot 10^5$) based on inlet velocity and blade chord length. The static pressure distribution at blade mid span was measured for stagger angle (24°) by using static pressure taps.

The numerical results obtained from different turbulence models simulations were compared with each other and with the experimental data in term of pressure distribution coefficients. The effects of different turbulence parameters on the numerical results were analyzed. Each turbulence model was individually reviewed for the correctness of its predictions and the best model in this set was chosen. This model was the RNG k- ϵ model.