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NUMERICAL SIMULATION ON PRESSURE SIDE FILM COOLING OF A GASE TURBIN BLADE WITH SHAPED INJECTION HOLES

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ABSTRACT A numerical research on the film cooling performance by shaped injection holes for the turbine blade pressure side in an engine-simulated environment was carried out. A three-dimensional Navier-Stokes code has been used to compute the film cooling effectiveness with over 8.15 million grid points being used to compute the flow over the blade using SST κ-ω model. The film cooling effectiveness distributions and detailed temperature distributions were presented along with the discussions on the influences of rotational speed, blowing ratio, and different hole-shapes. The rotation effects were clearly shown with the effective film cooling area graphs with rotational speed of 0.001117, 0.001229 and 0.00134 respectively. It was found that different rotation speeds significantly changed the film cooling traces and the adiabatic effectiveness was reduced with the rotating speed increasing. The blowing ratio has a notable influence on the adiabatic film cooling effectiveness downstream of the circular hole exit. The circular film jet easily separates from the blade wall under large blowing ratios. At higher blowing ratios, more coolant jet momentum was transferred to the tangent and lateral flow of the coolant jet issued from the film holes, resulting in a film cooling enhancement. Compared with the cylindrical hole, the fan-shaped hole and console hole have a better cooling advantage than the circular hole with rotating.