Abstract

Combustor liner requires significant amounts of cooling, since it is exposed to a great amount of heating from the combustion process. Turbine engineers incorporated various method to cool the liner. The most efficient method is the jet impingement cooling. Experimental investigation of the jet impingement cooling system is introduced in present study. Round jet holes of diameter (D) with inline array arrangement with jet to jet spacing of 4D are considered. Jet Reynolds number (R_{ej}) of 4000 to 16000 and jet spacing ratio of H/D= (2, 3, and 4) are investigated. The test section consistes of target plates having back side resistive film cooling, multiple jet holes plat, single crossflow exit and measuring instruments and devices. Four target plate models have been investigated; model (1) of plain surface inner, model (2) of longitudinal ribs, model (3) of lateral ribs and model (4) of grids ribs. The average wall cooling effectiveness and the average local heat transfer coefficient for the impingement system are evaluated. The experimental investigations are carried out, for model (1) with (H/D=2, 3 and 4), for models (2 and 3) with (H/D=2) and for model (4), the experiment with (H/D=2 and 3). In order to predict the flow behavior at the holes and downstream area (the generation of vortex, vortex type, and the interaction between jets), numerical solutions have been introduced using commercial CFD code ANSYS Fluent package 14.5.

For all models at H/D=2 the average heat transfer coefficient increased in the downstream direction (X) in the region laying between (X/D=0) to (X/D=32) for all (R_{ej}). The average heat transfer coefficient and average wall cooling effectiveness is increased with H/D decreased and high value is obtained at H/D =2. The average heat transfer coefficient and average wall cooling effectiveness are highly depended upon the jet Reynolds number and ribs arrangement. The heat transfer coefficient and wall cooling effectiveness are high for grid ribs case for all jet Reynolds numbers and (H/D). The results show that model (4) at H/D = (2) enhanced

both the average heat transfer coefficients and the average wall cooling effectiveness greatly, the maximum level of enhancement over that of model (1) fot heat transfer coefficient and wall effectiveness are (17.2 %) and (4.5%) respectively. The predicted flow field structures for model (4) shows that the flow field structure is dominated by high level of turbulence with a pair of vortex occupied the space between the grid ribs and the jet spacing and this predicted results assisted the test results.