

Accepted Manuscript

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PII: S1359-4311(17)32235-4

DOI: <http://dx.doi.org/10.1016/j.applthermaleng.2017.06.019>

Reference: ATE 10537

To appear in: *Applied Thermal Engineering*

Received Date: 4 April 2017

Revised Date: 21 May 2017

Accepted Date: 6 June 2017

Please cite this article as: D. Zheng, X. Wang, F. Zhang, Q. Yuan, Numerical investigation on the effects of the divided steps on film cooling performance, *Applied Thermal Engineering* (2017), doi: <http://dx.doi.org/10.1016/j.applthermaleng.2017.06.019>

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Numerical investigation on the effects of the divided steps on film cooling performance

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Abstract: Described in this paper is a numerical investigation on the concept for enhancing the film cooling performance by placing divided steps upstream the film cooling hole. Five different divided steps are investigated, including the cases of steps with 2.5mm, 5mm, 10mm, 15mm divided spacing in the middle, and 2.5mm divided spacing in both lateral sides. The effects of different divided spacing on film cooling performance are conducted. The film cooling performance on a flat plate and the film cooling with an undivided step are also presented as a contrast. The film cooling performance is evaluated at the density of 0.97 with the blowing ratios ranging from 1.0 to 2.0. Results obtained show that the film cooling performance with the steps divided in the middle is greatly improved when compared with the undivided step. Both the entrainment of coolant and the anti-kidney vortices are observed in the case of film cooling with divided steps and the film cooling performance is improved by the combined effect of the entrainment and the anti-kidney vortices. The total pressure loss for film cooling with divided steps is lower than that with undivided step. The film coverage effect and the adiabatic film cooling effectiveness for case with 5mm divided in the middle of the step are all the best among all the cases.

Key words: film cooling; divided upstream steps; flow structure; adiabatic film cooling effectiveness

1. Introduction

The efficiency of gas turbine is sought to increase continually by increasing its inlet temperature.

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