Review Comments on GT2019-91788

by Fraser Jones, Dale Fox, David Bogard, Thomas Dyson, Zachary Webster

I. Required changes roughly in the order of appearance:

1. In the introduction, there is only an extensive background introduction. The literature review **MUST** be required, particularly the work addressing RANS and other numerical methods in film cooling predictions.

2. Nomenclature, the first appearance of "VR velocity ratio" should be deleted.

3. P3, the first paragraph describing the measurements of thermal fields, a sensor diameter of 50 μm was used. Can the author explain how it works as it could too flexible to be deflected in the flows?

4. P3, Could the authors provide the measured velocity profiles of the mainstream and the crossflow? A channel of 450 mm in length was chosen to perform the separate boundary condition simulation. Why was it 450 mm? The same question is on the crossflow channel.

5. Please explain the ANSYS CutCell meshing technique? How was it applied in the code?

6. There is no turbulence model validation in the present paper and the review did not find it in other previous papers by the authors. Why was the Realizable k-epsilon model chosen as most past studies have reported the SST k-omega model generally performed better?

7. Fig. 4, the temperature of the mainstream inlet flow was 295K. However, in the previous experimental measurements by the authors it was 310K? Can the authors explain it?

8. P3, the last paragraph, it is mentioned that a prism layer was applied to the wall. What was the total height of the prism layer?

9. P3, it is better to see the results of grid-independent test.

10. P4, boundary condition, the authors stated that the measured turbulence level decay downstream of the grid matched the correlation. The authors should include the results in the paper, perhaps in Fig. 6.

11. P4, the last sentence of the first paragraph, it is stated that the inlet turbulence length scale was 8.5 mm, which corresponded well with the measured turbulence integral length scale of 10 mm. RANS simulations were shown to be poor in predicting turbulence length scale. Actually, this was also evident from the results by the authors. Furthermore, the turbulence integral length scale measured in experiments is usually much larger than that in RANS code (*Luo J, Razinsky E H, Moon H K, Three-Dimensional RANS Prediction of Gas-Side Heat Transfer Coefficients on Turbine Blade and Endwall,*

ASME Journal of Turbomachinery, 2012, 135(2): 021005).

12. P4, results, why did the authors not chose the same density ratio values as the iLES in the RANS to conduct more direct comparisons?

13. P6, the first line, the authors stated that the RANS computation showed a dip thermal interface at the middle of the hole very similar to the experimental measurements. However, the reviewer found an obvious discrepancy between predictions and measurements in Fig. 9.

14. P6, the internal cross-flow direction is from left to right, so the coolant flow would impact on the right side of the hole inlet, and then swirls to the left side as it exits the hole. Is this flow feature related to the hole length?

15. P6 & P7, Fig. 10(a), the RANS simulation showed rotational flow that was skewed to the right side of the hole. Why was the computational thermal fields at the hole exit in Fig. 9 symmetric?

16. P9, Fig. 13, could the authors explain why the film cooling effectiveness deceased and then increased with the increase of velocity ratio?

II. <u>A few minor points:</u>

1. In the abstract, line 9, "he" should be "the".
2. P4, "A mentioned previously" should be "As mentioned previously".
3. P4, "to" at line 6 of the third paragraph on the right should be deleted.
4. P5, "the dip the thermal interface" should be "the dip thermal interface"
5. P6, figure caption, "Figure 8" should be "Figure 9".
6. P7, "where measurements a flow…"should be "where measurements showed a flow…"