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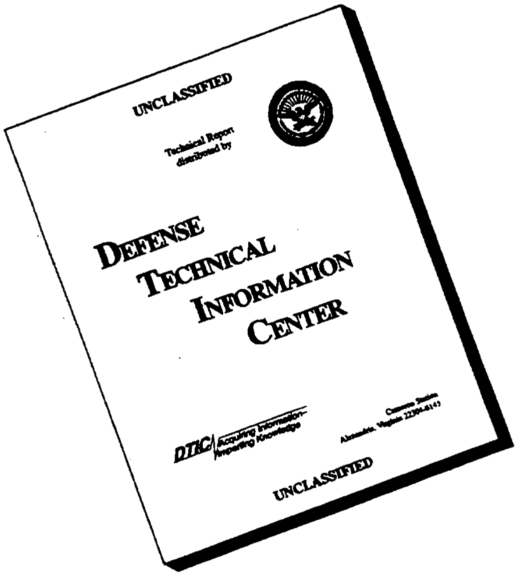

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TURBULENT HEAT TRANSFER INVESTIGATION: TURBULENCE LENGTH SCALES AND TURBINE HEAT TRANSFER

Jason Sharp
Pete Harris

3 MAY 1996

FINAL REPORT 1 NOVEMBER 1995--9 JULY 1996

Approved for public release; distribution unlimited

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RICHARD B. RIVIR
Manager, Aerothermal Research
Turbine Branch
Turbine Engine Division
Aero Propulsion & Power Directorate

CHARLES D. MACARTHUR
Chief
Turbine Branch
Turbine Engine Division
Aero Propulsion & Power Directorate

RICHARD J. HILL
Chief of Technology
Turbine Engine Division
Aero Propulsion & Power Directorate

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (*Leave blank*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	3 May 1996	Final 1 Nov 95 - 9 Jul 96

4. TITLE AND SUBTITLE

Turbulent Heat Transfer Investigation: Turbulence Length Scales and Turbine Heat Transfer

5. FUNDING NUMBERS

PE 61102F
JON 2307S315

6. AUTHOR(S)

Jason Sharp, Pete Harris

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Aero Propulsion & Power Directorate
Wright Laboratory
Air Force Materiel Command
Wright-Patterson Air Force Base, OH 45433-7650

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Aero Propulsion & Power Directorate
Wright Laboratory
Air Force Materiel Command
Wright-Patterson Air Force Base, OH 45433-7650
POC: Richard B Rivir, WL/POTT, 513-255-5132

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

WL-TR-96-2091

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

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12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

This experiment was designed to study the effects of turbulent length scales on turbine blade heat transfer in a steady state cascade wind tunnel. Turbine blade heat transfer is of interest due to the beneficial effects engine performance that can arise from improvements in turbine blade cooling and design. Turbulence in this experiment was generated by means of passive grids in the upstream flow. This experiment uses a steady state liquid crystal in combination with resistance heating to measure heat transfer. The liquid crystals provide surface temperature data and the resistance heating in the blade can be computed from measured currents to determine heat transfer. When combined with flow data taken with a hot film this allows for conclusions on the effects of length scales on heat transfer to be made. This experiment showed that the turbine blade heat transfer exhibited the trends already investigated for turbulence intensity, namely an increase in heat transfer with increased turbulence, the forward movement of boundary layer transition and the elimination of pressure side spanwise variations. Comparison of the two different length scales at the same turbulence intensity showed that the length scale evidenced no affect on transition location or post-transition heat transfer. However, pre-transition heat transfer was significantly increased as the integral length scale decreased from 2.78 to 0.51. This demonstrates that smaller more compact eddies in the turbulent flow have a more significant impact on increasing heat transfer than do larger eddies of the same intensity.

14. SUBJECT TERMS

15. NUMBER OF PAGES

53

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

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