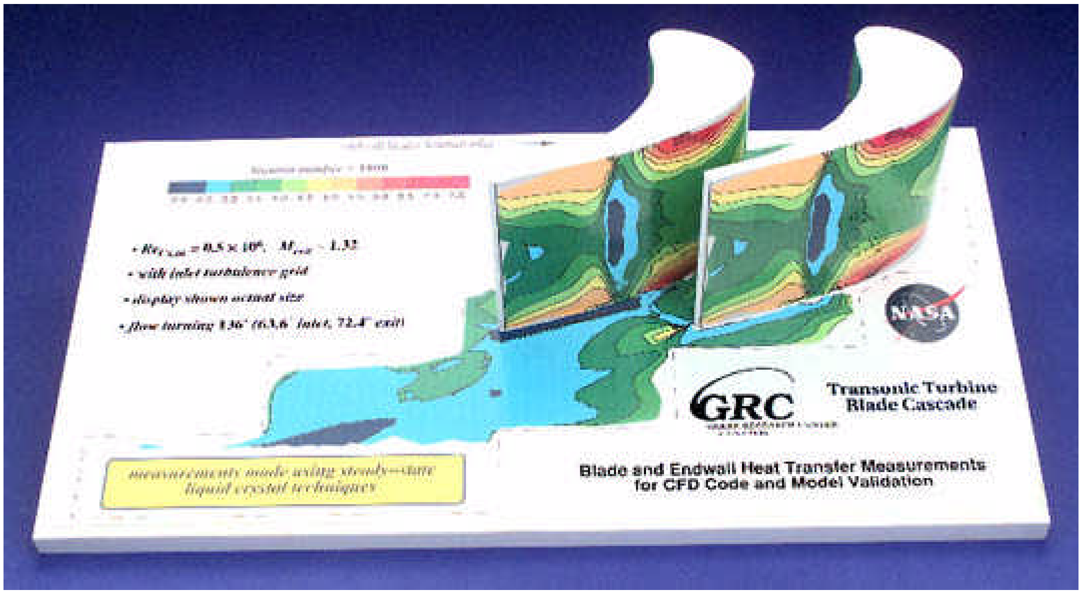
Turbine Blade and Endwall Heat Transfer Measured in NASA Glenn's Transonic Turbine Blade Cascade

Higher operating temperatures increase the efficiency of aircraft gas turbine engines, but can also degrade internal components. High-pressure turbine blades just downstream of the combustor are particularly susceptible to overheating. Computational fluid dynamics (CFD) computer programs can predict the flow around the blades so that potential hot spots can be identified and appropriate cooling schemes can be designed. Various blade and cooling schemes can be examined computationally before any hardware is built, thus saving time and effort. Often though, the accuracy of these programs has been found to be inadequate for predicting heat transfer. Code and model developers need highly detailed aerodynamic and heat transfer data to validate and improve their analyses. The Transonic Turbine Blade Cascade was built at the NASA Glenn Research Center at Lewis Field to help satisfy the need for this type of data.



Display model of blade and endwall heat transfer measurements from the NASA Transonic Turbine Blade Cascade.

The Transonic Turbine Blade Cascade facility can match engine conditions through pertinent flow parameters such as the Reynolds number, the Mach number, and the inlet turbulence levels. Future high-pressure turbines will eliminate blade rows by producing higher loading on a single stage. Single-stage turbines inherently have regions of supersonic flow and a high degree of flow turning, both of which are reproduced in the facility. A long inlet section is used to build up thick inlet boundary layers. These boundary layers, combined with the high flow turning, result in highly three-dimensional flow in the blade passage, again representative of flow in an actual engine. The large scale, lower temperatures, and liquid-crystal temperature measurement technique allow for very detailed, full surface measurements to be obtained on the blades and endwalls. The generic, next-generation test blade was designed with a relatively large, blunt leading edge that reduced the peak heat transfer typically observed near the stagnation region. The full surface blade and endwall data obtained in the facility have been made available on compact disks for a variety of flow conditions.

Bibliography

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Abstracts of these publications are available online http://www.grc.nasa.gov/WWW/TURBINE/Turbine.htm (select "Publications," then refs. 52, 54, and 53, respectively).

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