

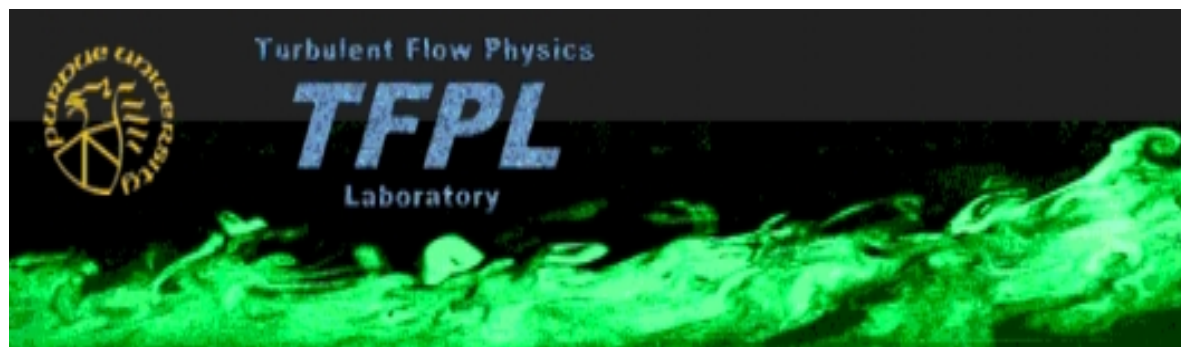
Airfoil Trailing

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Edge Cooling

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PROBLEM

Efficient and clean gas turbines require higher gas temperature at the first stage rotor. Critical to achieving this goal is the reduction of cooling flow to the trailing edge of the first vane, where a careful compromise between performance and structural integrity must be achieved.

OBJECTIVES

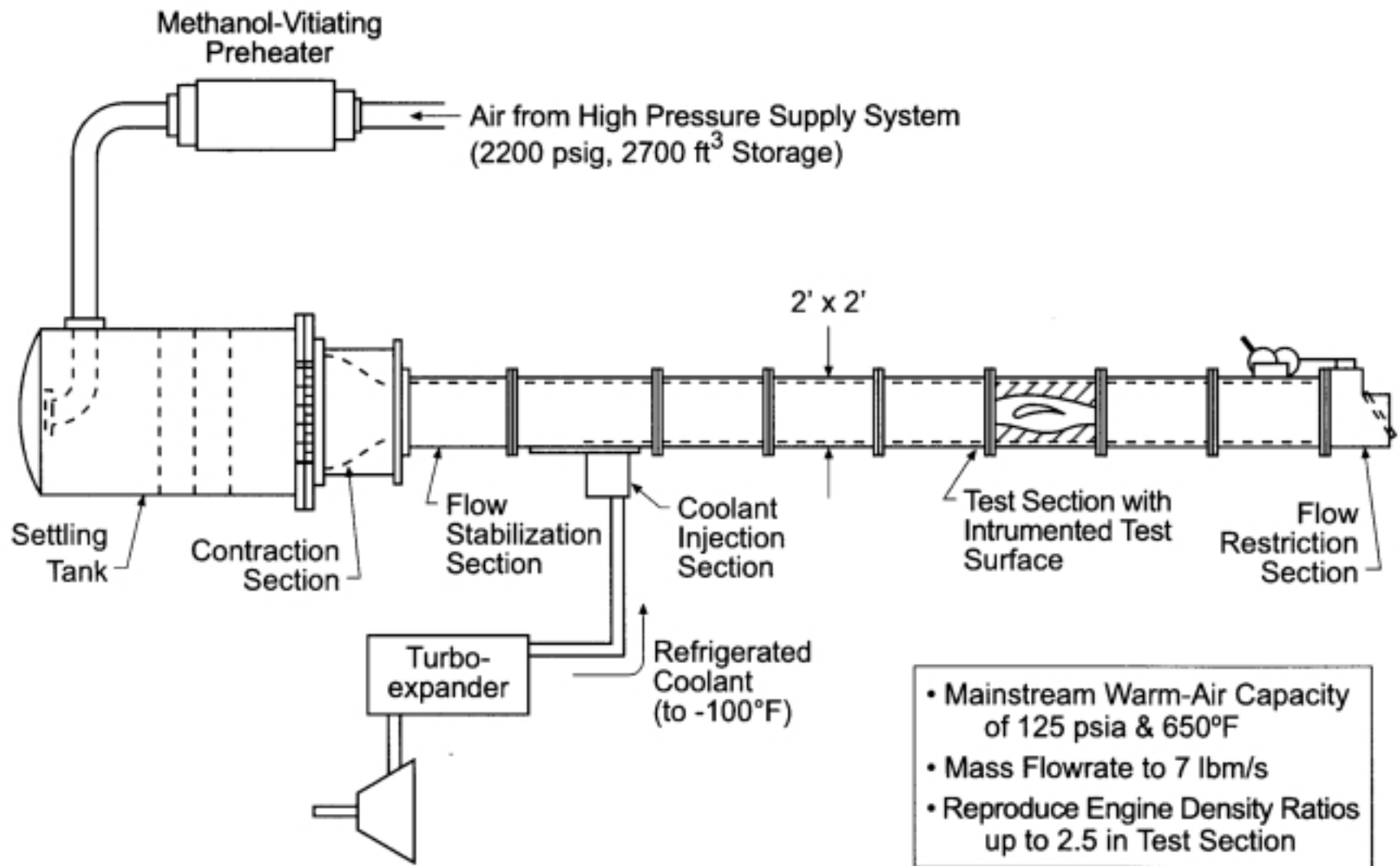
- Provide the gas turbine industry with critically needed information on vane trailing edge heat transfer
- Use this knowledge to provide insight into the optimal balance between aerodynamic performance and heat transfer

- Assess the effects of several key factors:
 - Trailing edge geometry
 - Reynolds number
 - Compressibility
 - Blowing ratio

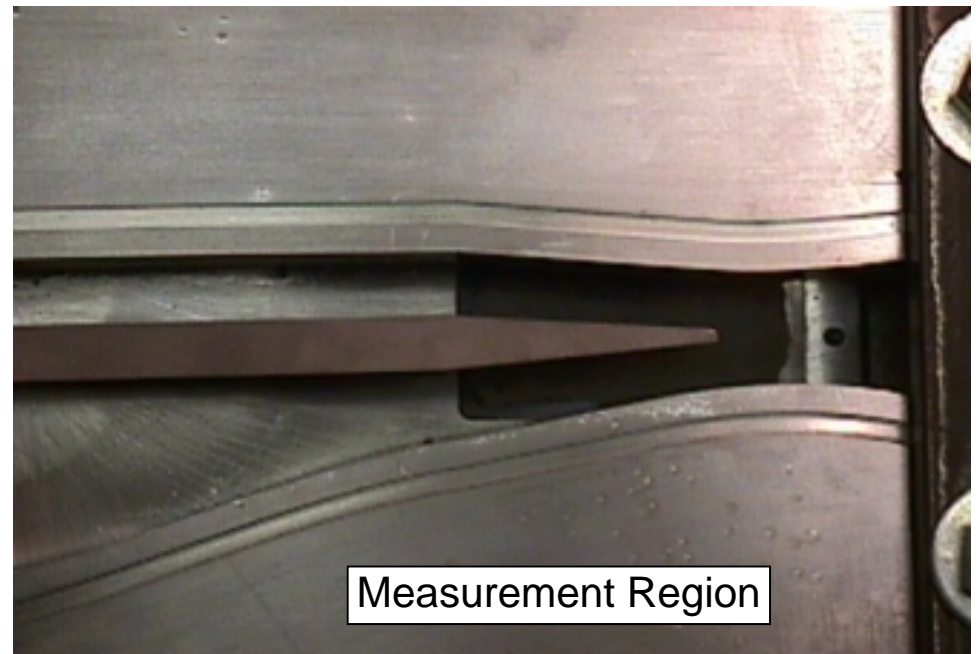
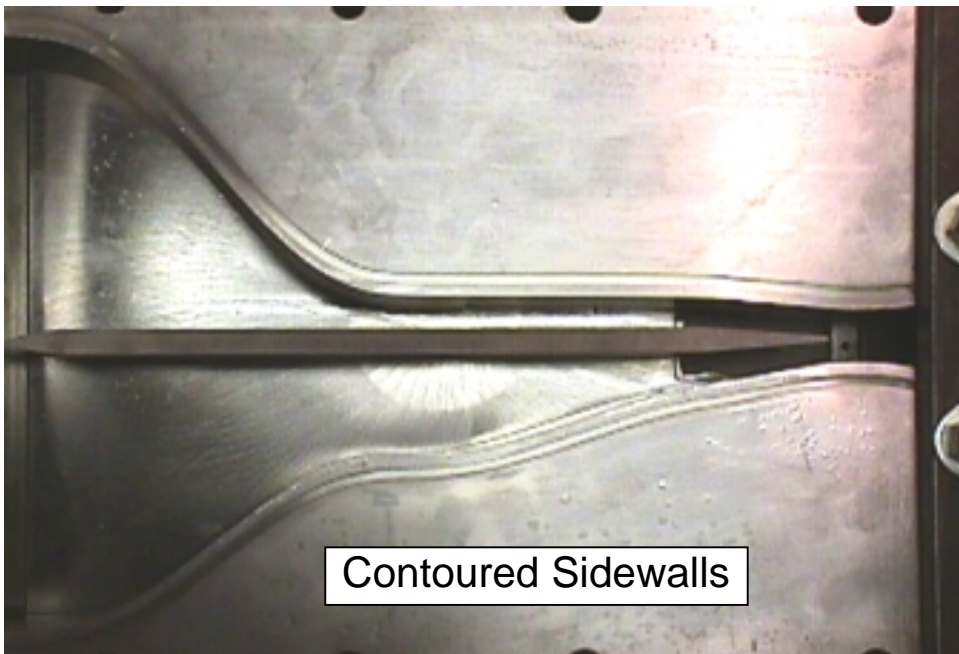
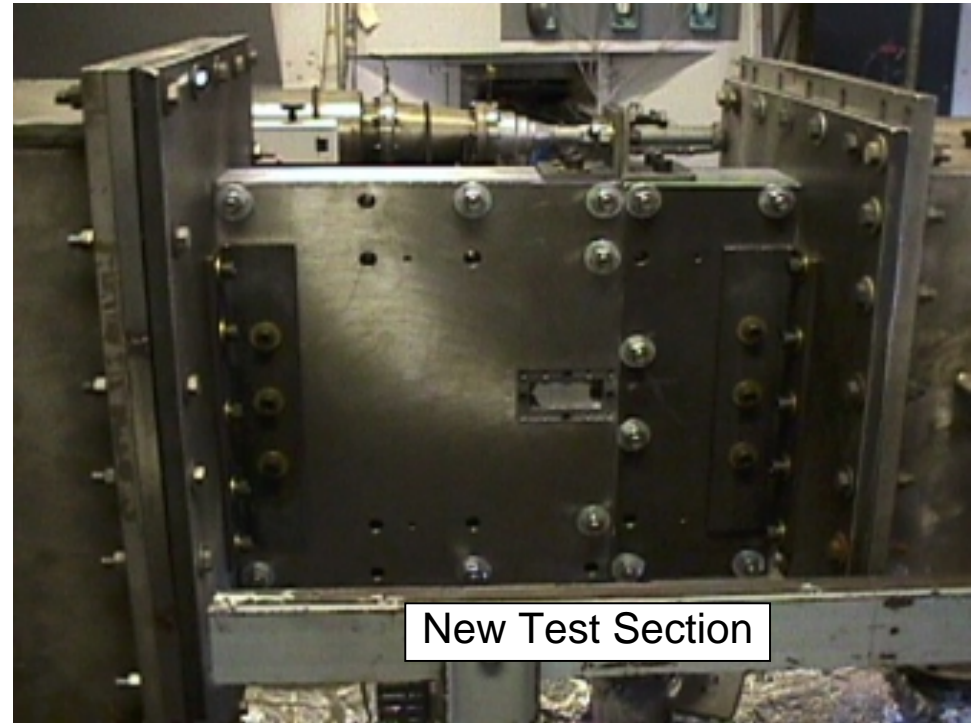
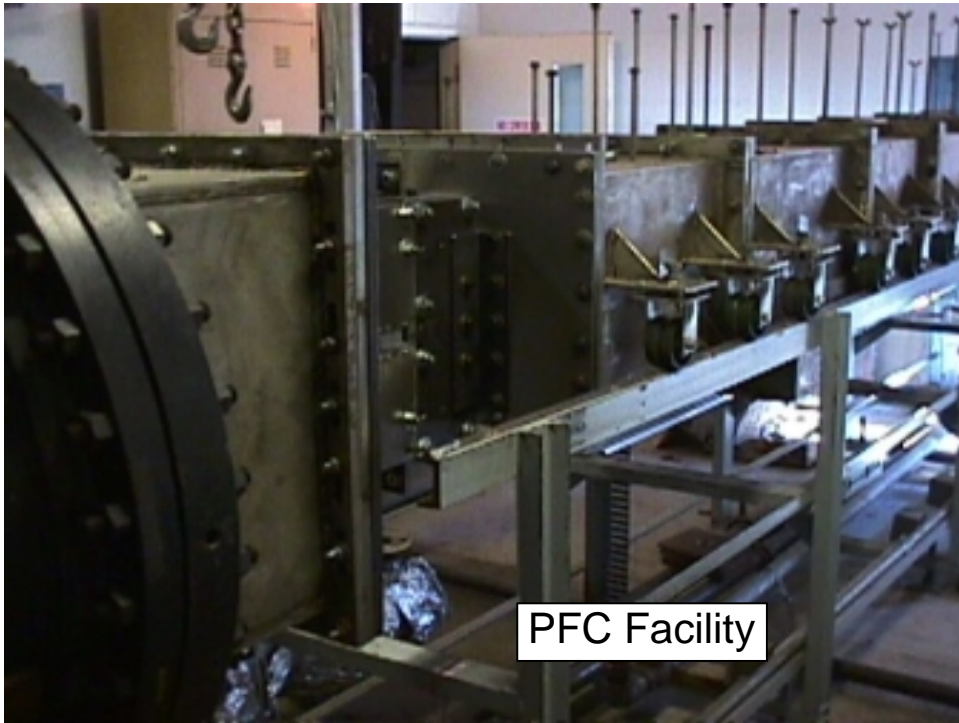
EXPERIMENTAL APPROACH

Experiments in the Purdue Film Cooling Facility with representative geometries at realistic Mach numbers

PURDUE FILM COOLING FACILITY

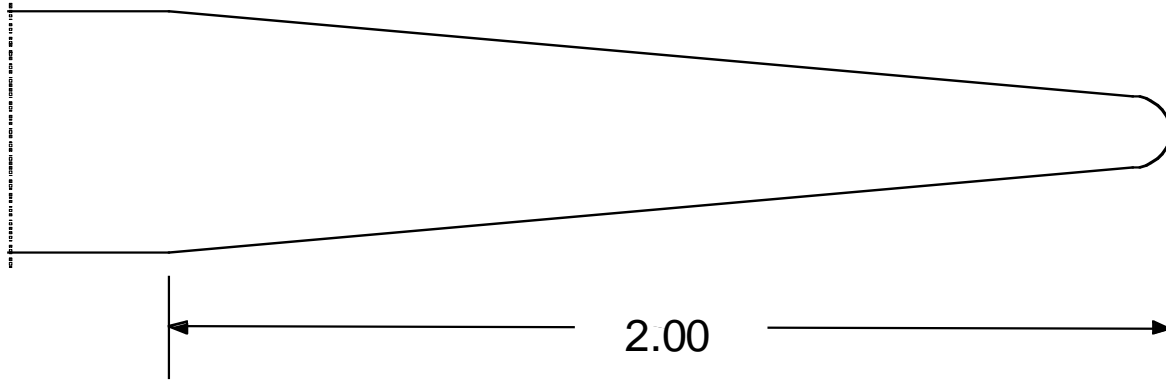


AIRFOIL TRAILING EDGE COOLING TEST SECTION

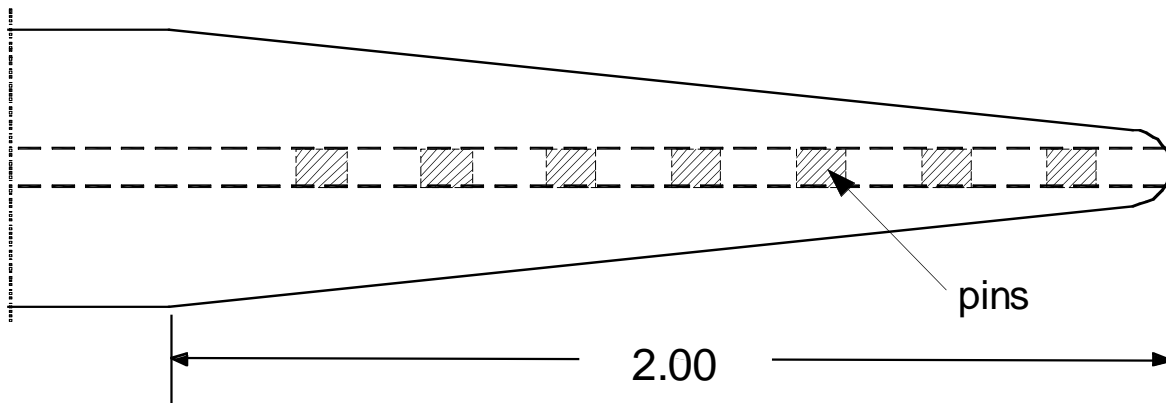


GEOMETRIES TO BE EVALUATED

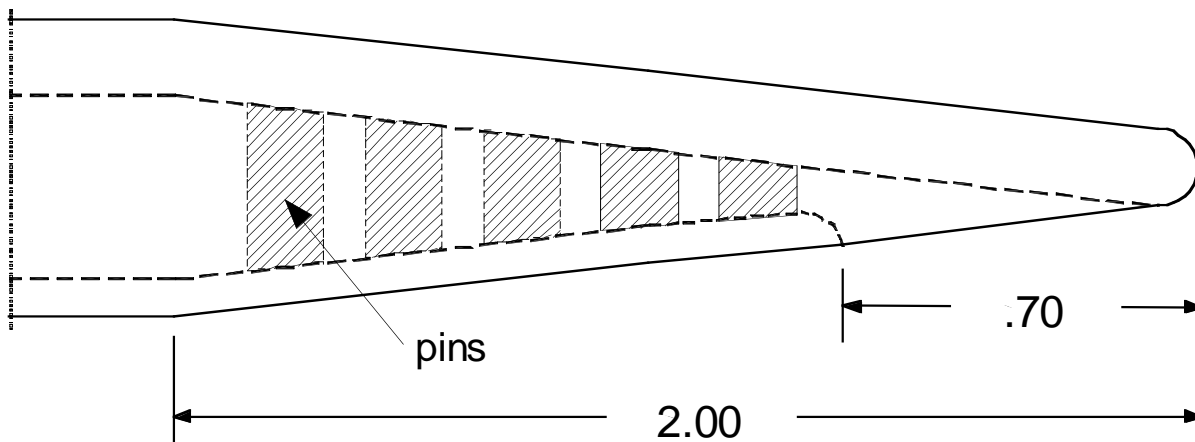
Baseline (No Discharge) 10 deg Wedge Angle



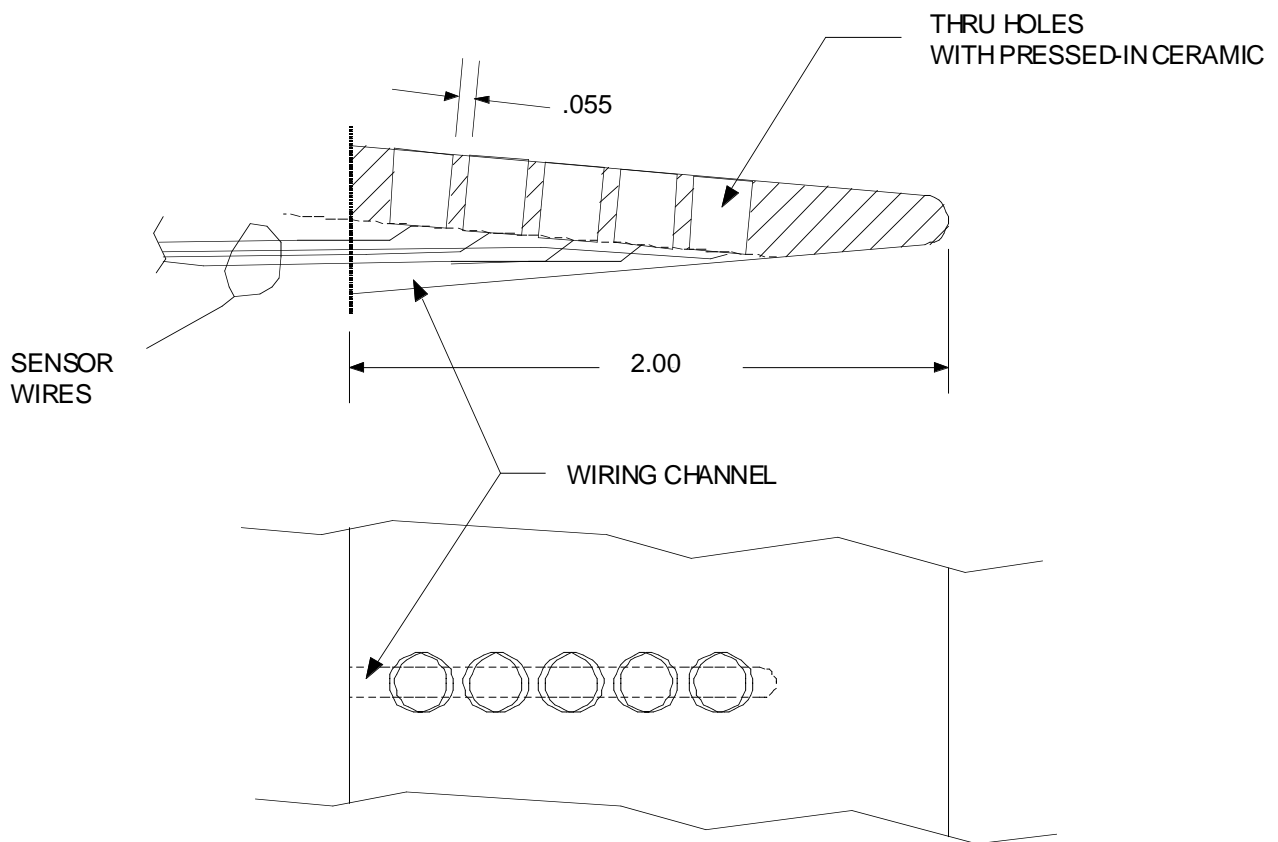
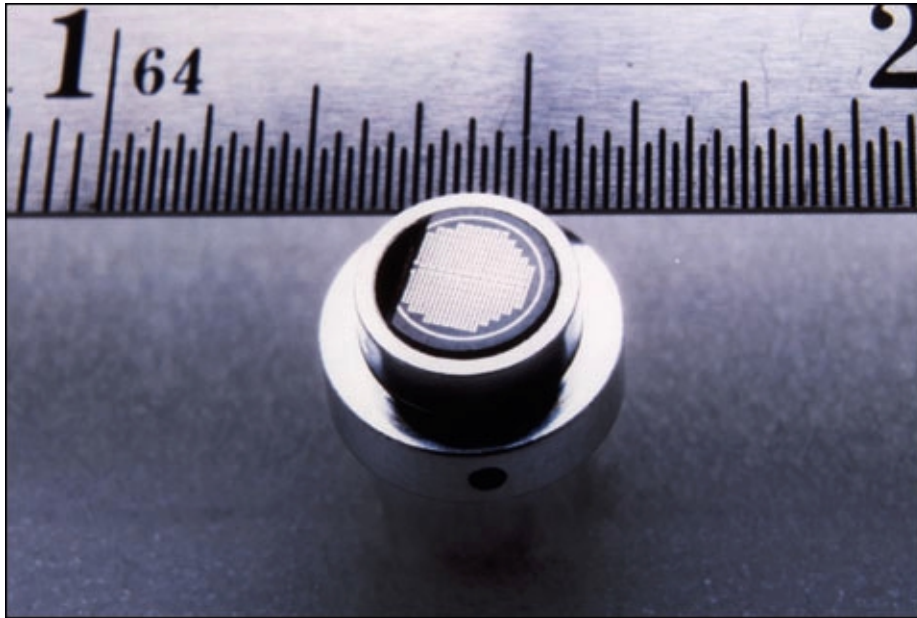
Covered Discharge



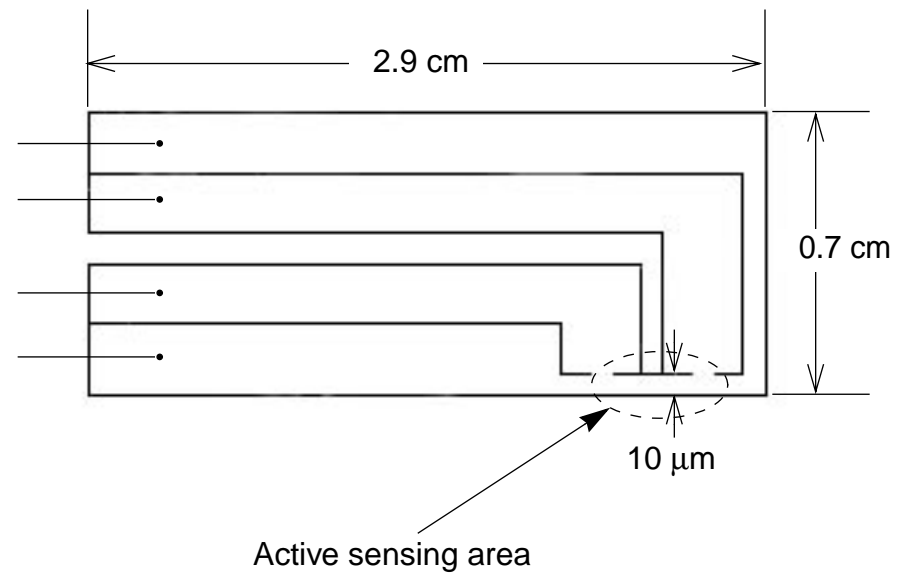
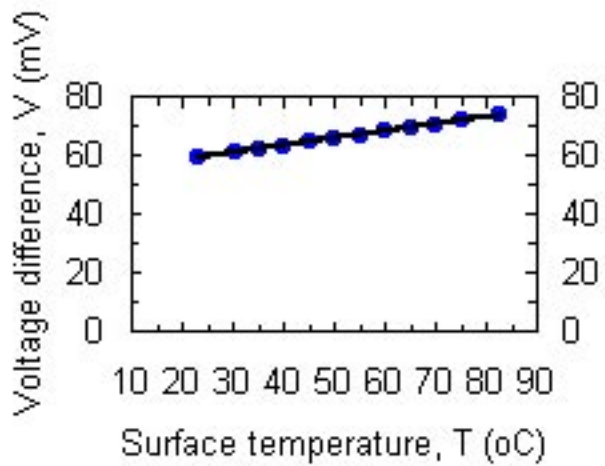
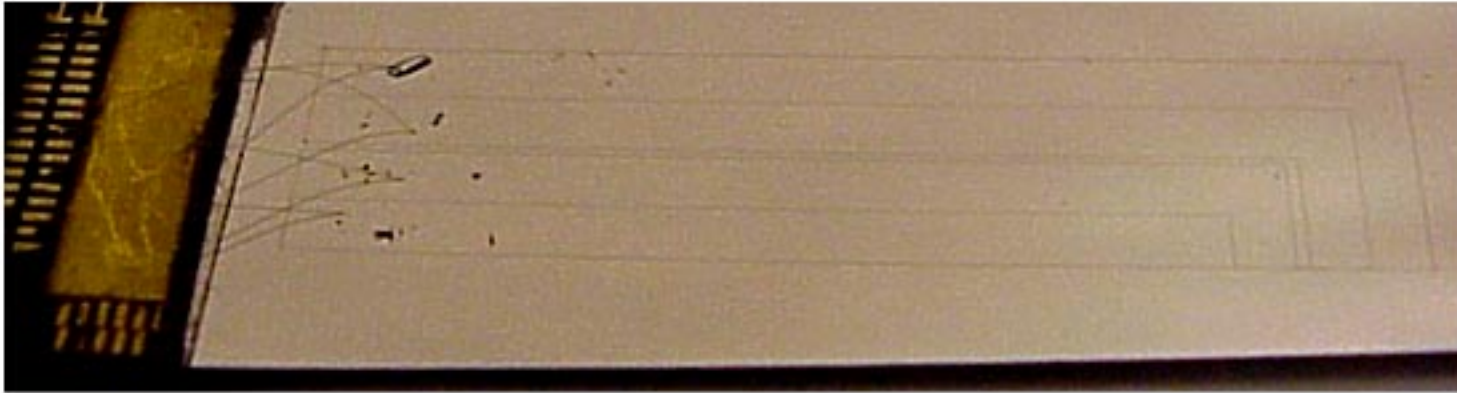
Gill Slot Discharge



HEAT FLUX MICROSENSORS



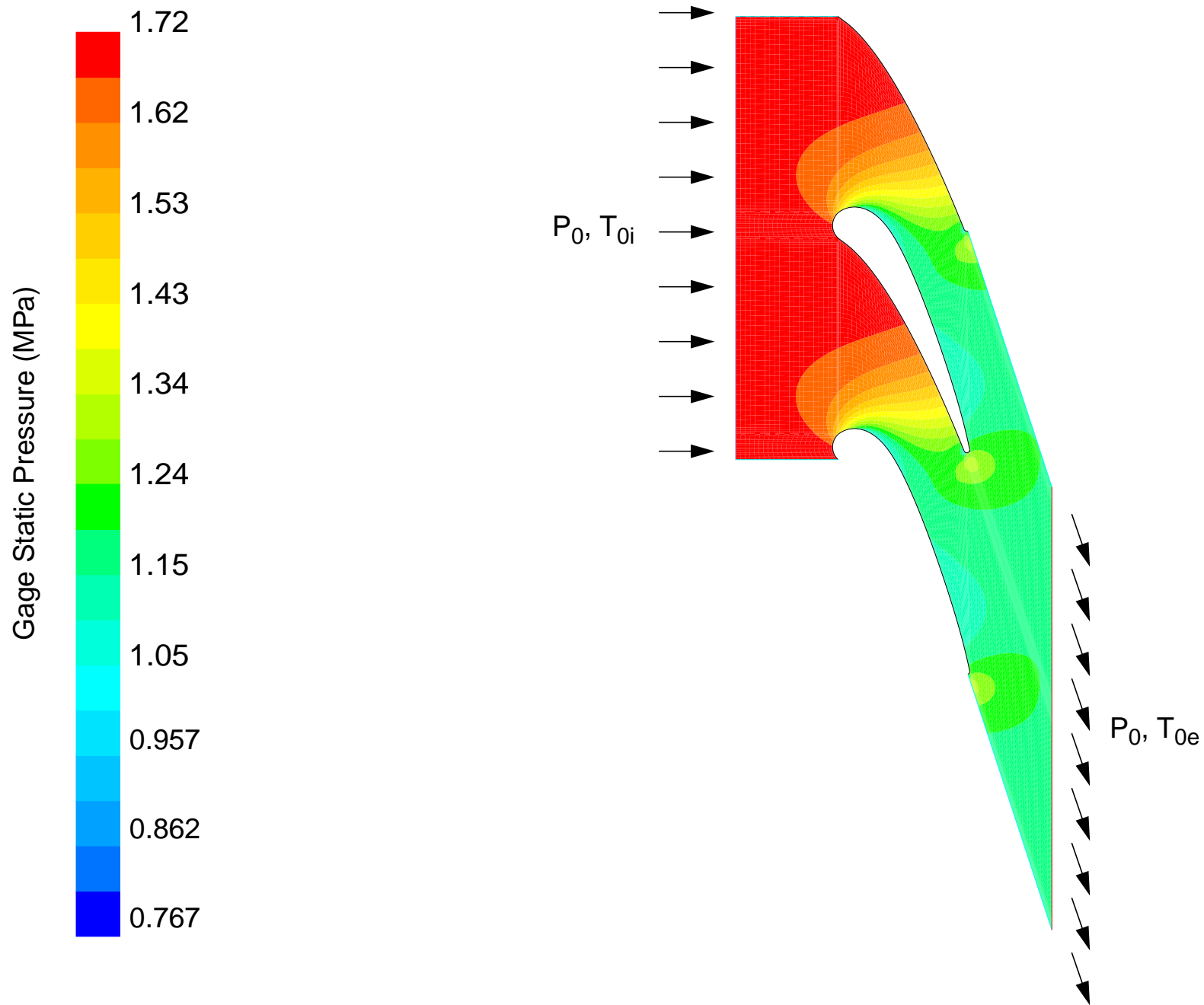
THIN-FILM HEAT FLUX GAUGE



COMPUTATIONAL APPROACH

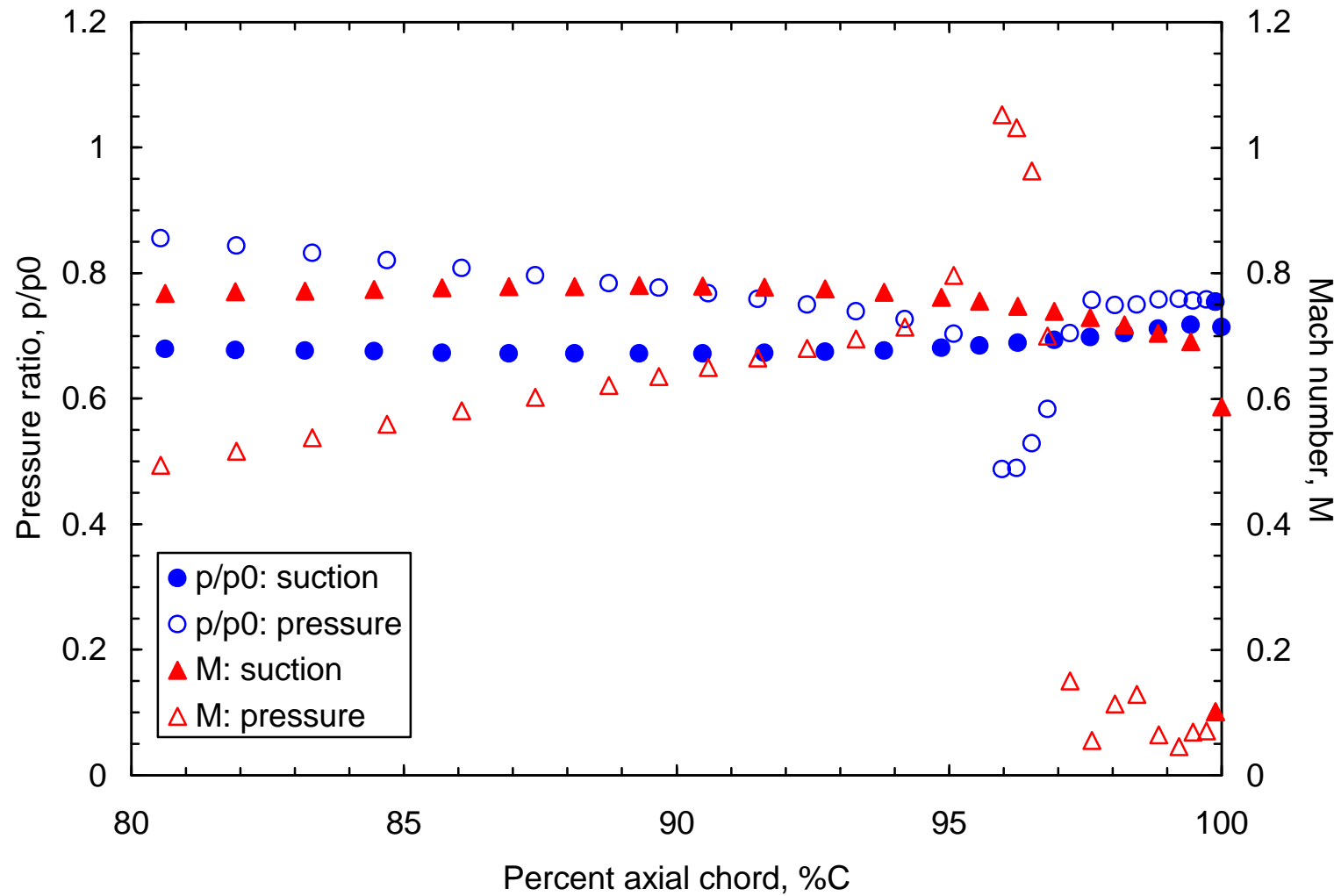
CFD studies to add insight and to determine limitations of current numerical simulation techniques

PRESSURE DISTRIBUTION

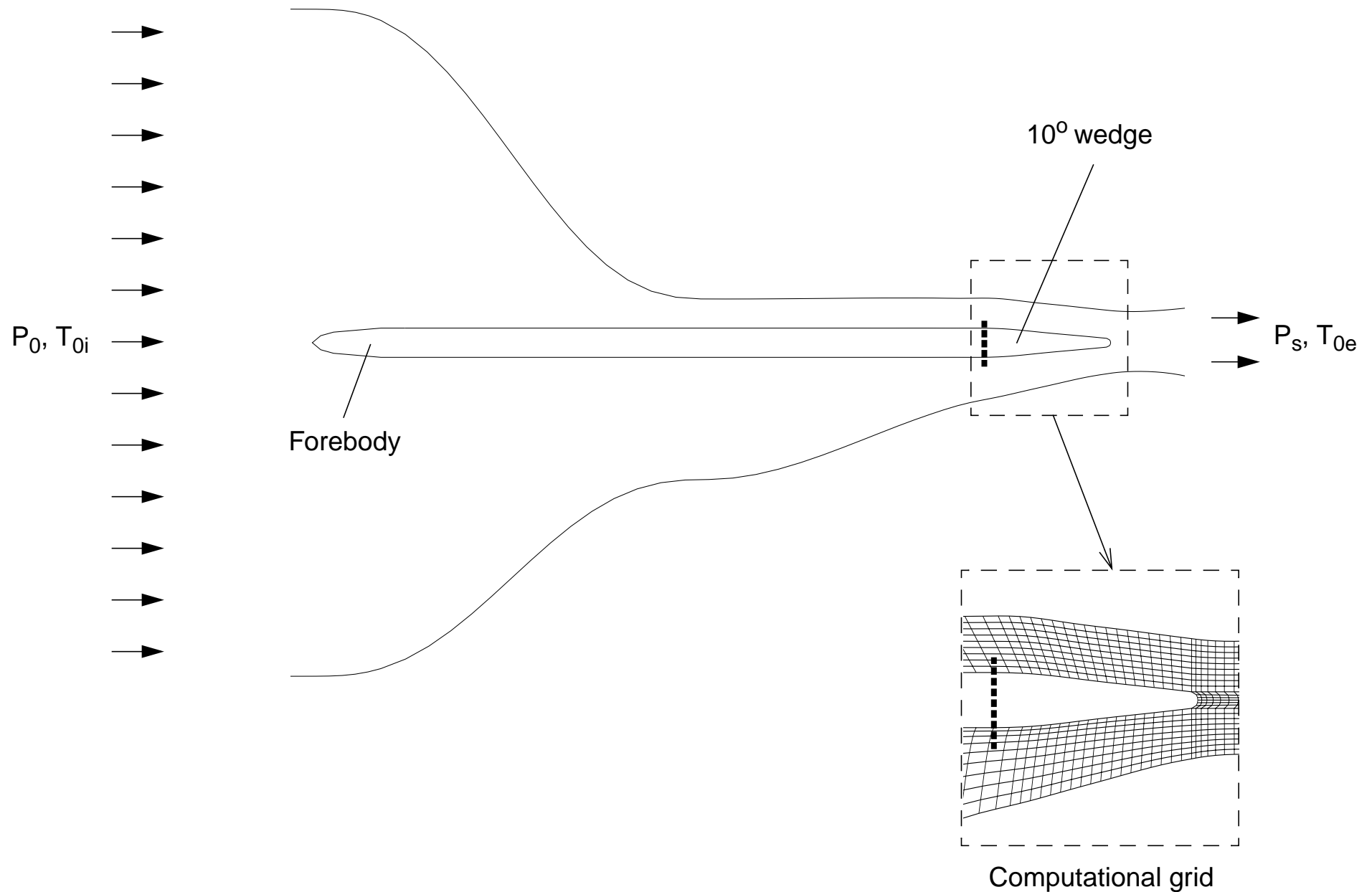


PRESSURE RATIO AND MACH NUMBER

Computed inviscid flow over actual vane

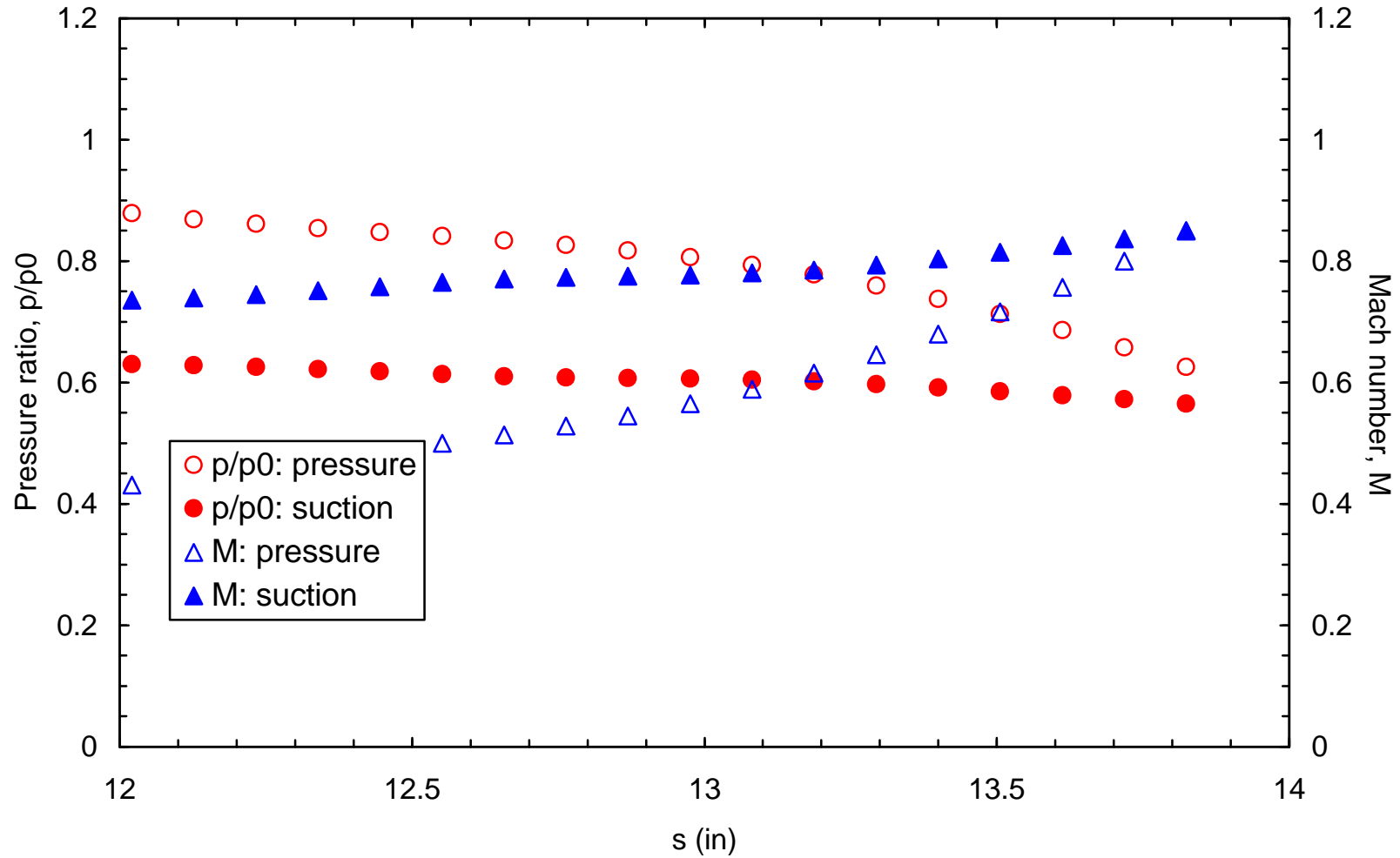


TEST SECTION AND FLOW COMPUTATION



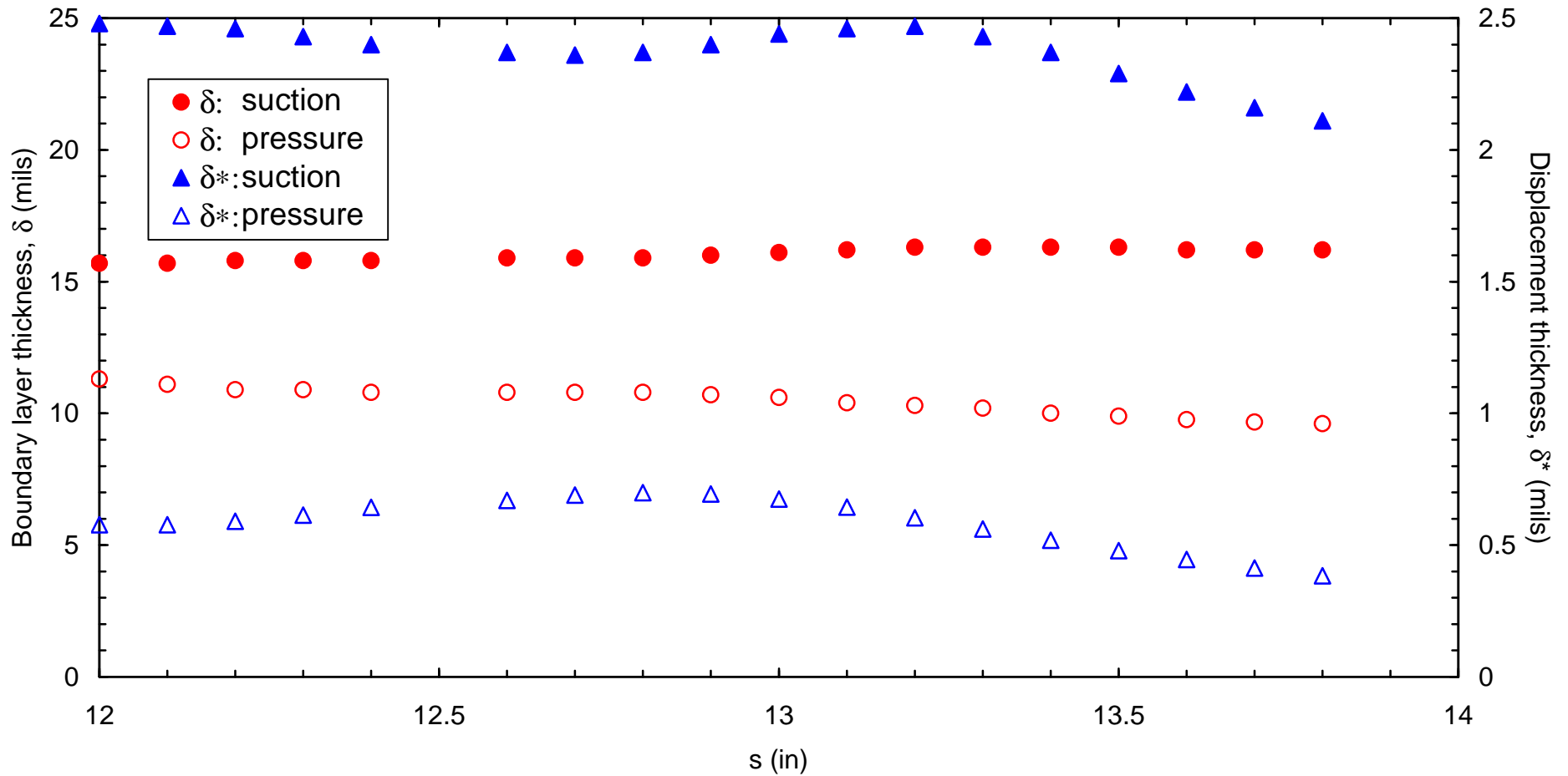
PRESSURE RATIO AND MACH NUMBER

Trailing edge portion of test article



BOUNDARY AND DISPLACEMENT THICKNESSES

Trailing edge portion of test article



NUSSELT NUMBER AND HEAT TRANSFER COEFFICIENT

Trailing edge portion of test article

