GAS PATH TEMPERATURE MEASUREMENTS IN HIGH TEMPERATURE GAS TURBINE ENVIRONMENTS

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One of the approaches to improve the gas turbine efficiency is increasing the turbine inlet temperature. The highest temperature in the gas turbine cycle occurs at the exit of the combustion chamber and it is limited by the maximum temperature that the turbine blades can withstand. Over the years, the development of new materials and innovative cooling techniques permitted this turbine inlet temperature increase up to 2000K in modern gas turbine engines of today. In order to assess the gas turbine efficiency, it is of great importance to measure the gas temperature in the turbine inlet. Accurate gas temperature measurements in the high temperature gas turbine environments are also required for component residual life prediction methods, cooling system design, combustor performance assessment and optimum engine control technologies.

The aim of this project is to design a temperature probe for gas path temperature measurements in the hot sections of industrial gas turbines or aero-engines. The temperature probe concept is based on the use of a conventional thermocouple, commonly used by engine manufacturers, as a temperature sensing element. The temperature probe is designed to have the capability of performing measurements at the typical high pressure turbine exit. The design conditions are up to 1500K and 10 bars for total temperature and total pressure, respectively.

Designing a thermocouple probe means to provide a suitable environment for the thermocouple junction in order to decrease the temperature measurement errors. These errors are velocity error, conduction error, radiation error and transient error when the environment temperature changes with time. In this project, the velocity error is studied and the optimum Kiel head geometry which makes the recovery factor value as close as to one is determined. In order to determine the recovery factor of the thermocouple probes designed at VKI, the free jet calibration tests are conducted at C4 facility.

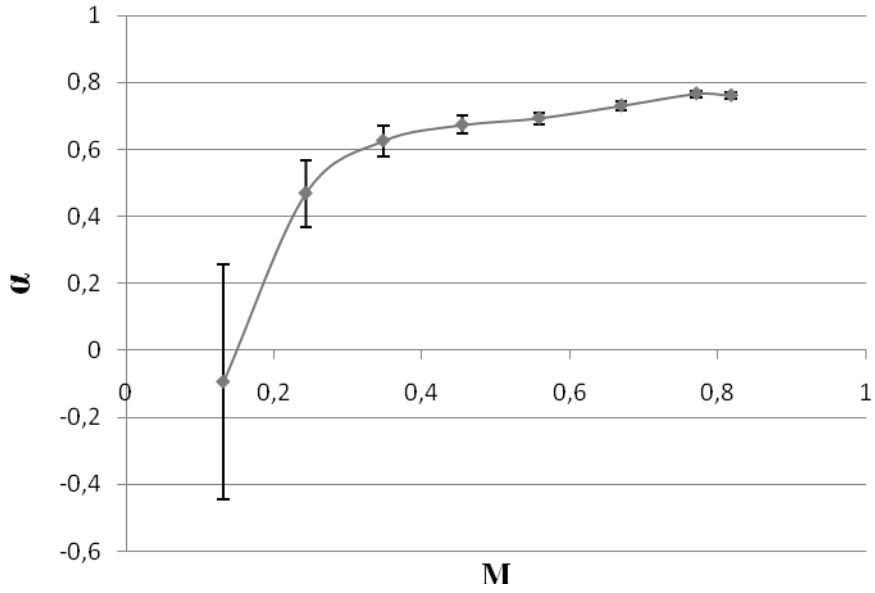

Figure 1: The recovery factor of thermocouple probe (VKI TC7)