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A LASER DOPPLER ANALYSIS OF THE IMPACT OF FLOW BOUNDARY CONDITIONS ON THE PERFORMANCE OF A MODEL LEAN-PREMIX COMBUSTOR

By

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ABSTRACT

The increasing regulation of pollutants emissions from aero-engines has stimulated the development and test of new technologies. In particular, the demands for low NO_x emissions and high combustion efficiency has led to designs which involve the combustion of premixed fuel and air at equivalence ratios which are close to those of the lean flammability limit. This, in turn, has led to problems of flame stability and pressure oscillations within the combustor and associated ducting.

This paper is aimed to improve our knowledge of the physics of typical flows in prevaporising and premixing ducts and of the subsequent lean combustion process, making use of an experimental study of the flow in a “Lean Premix Prevaporising”, LPP, gas-turbine model combustor. The experiments were performed at atmospheric pressure and were intended to provide a simple case to analyse the interactions between the flow conditions in the fuel preparation duct, the flame stabilisation process and the downstream combusting flow, in practical aero-engines combustors.

The results consider conditions for which low NO_x emissions are obtained together with high fuel efficiencies for very lean conditions and high swirl flows in the prevaporising duct. The effect of the gas residence time in the combustor primary zone is shown not to be a determinat factor for temperatures below 1400°C , and this can be used to optimise the fuel efficiency in practical combustors. In addition, results obtained for different turbulent flow conditions did not alter NO_x emissions, for the range of experimental conditions considered. For premixed lean-flames close to the flammability limit (temperatures below 1300°C) the contribution of *Thermal* and *Fenimore NO formation mechanisms* was found to be relatively small. The N_2O pathway can be the dominant route to NO formation under these conditions.

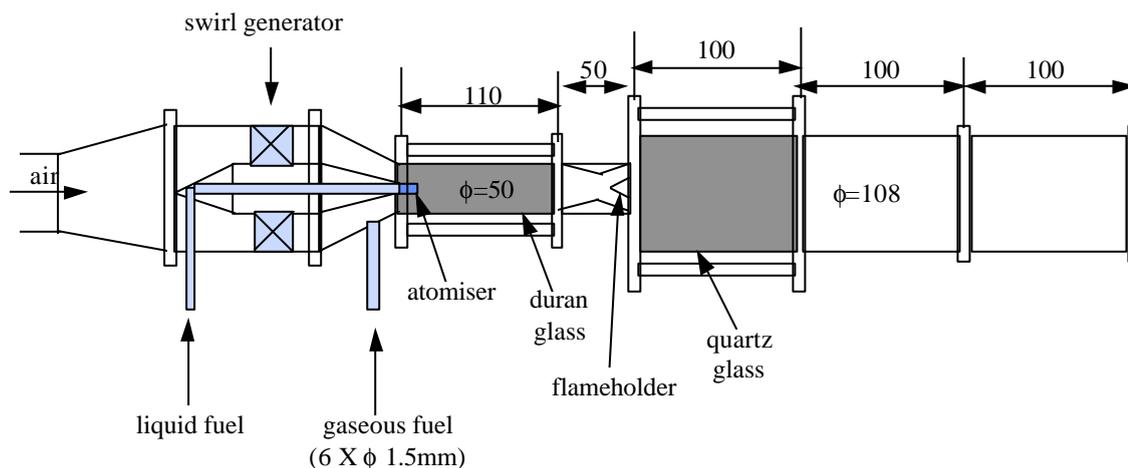


Figure 1 – Schematic drawing of the test rig