INFLUENCE OF RADIAL INJECTED FLOW ON THE AEROACOUSTIC COUPLING IN SOLID PROPELLANT BOOSTERS

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The aeroacoustic problems in solid propellant boosters, related to Ariane-5 booster, are being investigated at the VKI. The booster is composed of 3 cylindrical segments, which are separated by inhibitors, and a nozzle. The objective is to clarify the effect of the nozzle design on sound production, carrying out cold flow experiments. Acoustic pressure measurements are performed in a 1/30 scale axisymmetric model of the Ariane-5 with either pure axial or radial injected flows, to identify flow-acoustic coupling and to characterise the influence of the nozzle on the pressure fluctuation levels.

Under axially injected flow conditions, parametric tests were performed to understand the nozzle effect on the pressure fluctuation levels. Tests were carried out for different nozzle geometries, for different values of inhibitor-nozzle distances and inhibitor internal diameters, in a Mach number range of 0.03-0.14. A strong effect of the nozzle design on the amplification of the pressure fluctuations is observed. The results are compared with the database, which has been obtained before.

Under radially injected flow condition, a new 1/30 scale axisymmetric model (Figure 1) of Ariane-5 booster was built to investigate the instability cases with and without obstacle. As a first task, the flow field in the set-up is qualified by comparison of theory and experiments. Then, the aeroacoustic behaviour of the model is observed for different obstacle configurations and for different nozzle geometries. (Figure 2). A cavity effect is observed from the radial injection (Figure 3 and Figure 4) or when the inhibitor is away from the nozzle.

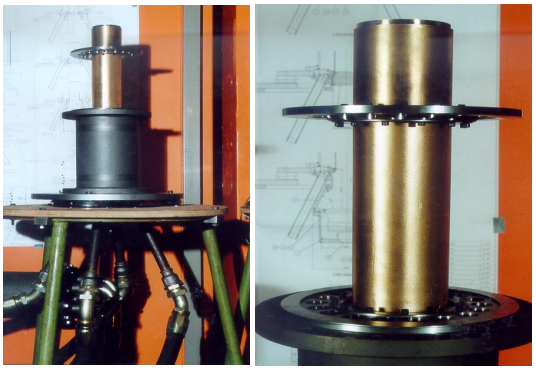

Figure 1- The new 1/30 scale axisymmetric set-up

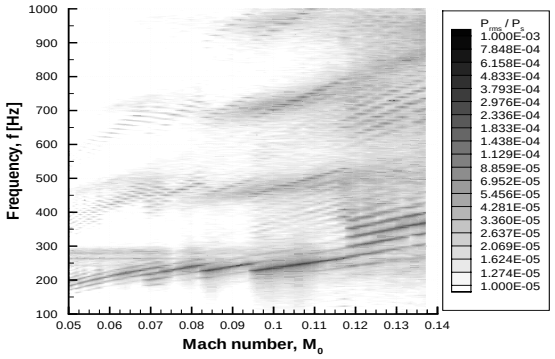

Figure 2- An example of flow-acoustic coupling

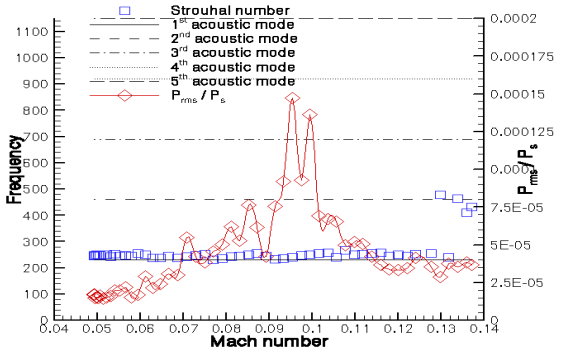

Figure 3- Evolution of the Strouhal number and pressure fluctuations with Mach number in a nozzle with cavity (without inhibitor)

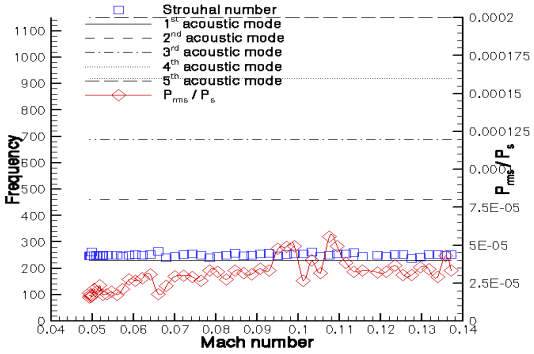

Figure 4- Evolution of the Strouhal number and pressure fluctuations with Mach number in a nozzle without cavity (without inhibitor)