

SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (2) (2)

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SEGMENTED SRM PRESSURE OSCILLATION DEMONSTRATOR

Abstract

Large rocket motors, especially those with segmented grains, often exhibit pressure and thrust oscillations caused by coupling between large scale vortices (vortex shedding) and the acoustic modes of the chamber. The pressure oscillation of most concern in large motors is the longitudinal modes roughly corresponding to the first acoustic modes of the motor. The resultant thrust oscillations are a small percentage of the overall thrust level, but this excitation source can have major impact on the designs of the motor components, flight vehicle structure, avionics, and payload.

For a typical example of a segmented motor, the Ariane 5 solid rocket motor, scale one tests to improve motor behavior regarding these issues are very expensive and at insufficient time pace, so that they cannot be uniquely dedicated to pressure oscillations. An overview of existing subscale test means in Europe show that they are not representative enough of relevant physical phenomena to expect good results. Nevertheless simulation tools and understanding of the phenomena have considerably progressed over the last ten years in Europe. So it appeared highly necessary to set-up a subscale test motor at a mid-scale to validate these simulation tools on real representative tests at a reasonable cost and time pace. Such a test mean will of course allow quantifying and evaluating the effects of influent parameters regarding pressure oscillations issues and assessing pressure oscillation behavior of new SRM configurations.

CNES initiated some years ago an analysis of such a 'Pressure Oscillation Demonstrator'. Currently an ESA/CNES program named POD-X (Pressure Oscillation Demonstrator eXperimental) has been decided and is performed by an industry team led by Europropulsion and involving Avio SPa, SME (Safran Group), Von Karman Institute, Snecma Propulsion Solide (Safran group) and DGA/EM test centre.

The first goal of this program is to validate a subscale MPS design (scale 2/9 has been selected) within two firing test evidencing that physical parameters (mainly Vortex Shedding phenomenon) are correctly reproduced. These tests are planned in 2013 and 2014.

After this validation phase, this test mean will allow to quantify and evaluate the effects of influent parameters regarding pressure oscillations issues and to prepare evolution for scale one implementations if needed at launcher system level. Being designed following a modular concept, this test mean will be able to be tuned to other solid rocket motor configurations.