IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (1) (3)

Author: Dr. Mario Tindaro Migliorino
Sapienza University of Rome, Italy, mariotindaro.migliorino@uniroma1.it

Mr. Manuel Aiello
Sapienza University of Rome, Italy, aiello.1702869@studenti.uniroma1.it
Mr. Matteo Berti
Sapienza University of Rome, Italy, berti.1745173@studenti.uniroma1.it
Mr. Marco Rotondi
Sapienza University of Rome, Italy, marco.rotondi@uniroma1.it
Dr. Simone D'Alessandro
Sapienza University of Rome, Italy, simone.dalessandro@uniroma1.it
Prof. Daniele Bianchi
Sapienza University of Rome, Italy, daniele.bianchi@uniroma1.it
Dr. Munzer Jahjah
Italian Space Agency (ASI), Italy, munzer.jahjah@asi.it
Dr. Marco Pizzarelli
Italian Space Agency (ASI), Italy, marco.pizzarelli@asi.it

STUDENT FIRING TESTS AND LAUNCHES WITH COMMERCIAL AND SELF-MADE SOLID ROCKET MOTORS

Abstract

This paper presents activities of a team from Sapienza University of Rome, in collaboration with the Italian Space Agency, on the design, test, build, and launch of single-stage rocket models up to altitudes of 1 km. Commercial and self-made solid rocket propellants are experimentally characterized with a lab-scale test bench. Moreover, near-future activities with hybrid propellants are planned with an advanced version of the test bench. In order to guarantee low-cost, non-toxic, and safe operations suitable for university experiments, firing tests with gaseous oxygen and commercially available microcrystalline waxes are planned.

The experimental test bench includes a combustion chamber, a nozzle, pressure transducers, and thermocouples. It is designed to sample thrust, temperature, and pressure data which are needed for the analysis of the engine's performance and efficiency. A modular structural design is envisioned in order to allow testing of different engine configurations. Firing tests have already been performed with a self-made solid propellant obtained as a mixture between potassium nitrate (KNO3) and sorbitol (C6H14O6), yielding thrust of about 150 N. The same test bench is being upgraded to allow gaseous oxidizers to be fed into the combustion chamber by integrating a tank, valves, and piping to the existing hardware.

Launches of rockets weighing up to 1 kg are also planned by employing commercial components and the self-made solid motor. Additive manufacturing is employed for building specific parts such as the nosecone, fins, and videocamera housing. The payload consists in self-programmed board computers which regulate rocket-nosecone apogee separation and record telemetry during flight. The rocket is then recovered through descent controlled by parachutes.

The activity presented in this paper is part of a multidisciplinary project aimed at building sounding rockets to be used as technological demonstrators and for educational purposes.