SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (3)

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DEVELOPMENT OF A LIQUID OXYGEN-METHANE TECHNOLOGY DEMONSTRATOR BASED ON REGENERATIVE COOLING IN THE FRAMEWORK OF THE HYPROB PROGRAM

Abstract

The HYPROB program is carried out by CIRA under contract by the Italian Ministry of Research with the main objective to improve Italian technology capabilities on liquid rocket engines for future space applications, with specific regard to LOx/LCH4 propulsion. In the frame of the HYPROB Program, the HYPROB-BREAD project has been defined in order to develop and test a LOX/LCH4 thrust chamber ground demonstrator and associated breadboards for design verification.

The demonstrator high-level requirements can be summarized as follows: • Thrust class of 30 kN, relevant to future applications of space propulsion -Pressure-fed testing -Regenerative cooling with liquid methane representative of heat exchange processes of an expander cycle engine. The 30 kN class of the demonstrator has been selected as the most appropriate to ensure scalability and representativeness of the test for future space applications, in order to take full advantage of previous experience of prototype research. The couple oxidizer fuel LOX/LCH4 have been selected, coherently with national programmatic guidelines, in synergies with the developing Italian capability in Liquid Rocket Engines design and research. That development approach has been defined in order to proceed step by step, from the understanding of the basic physical phenomena i.e. combustion and heat transfer, and then to validate design and analysis methodologies by simple breadboards, for risk mitigation purposes. In this paper the development processes of the demonstrator will be emphasized, in order to describe the build up of the design and technological processes to achieve the project goal. Main focus will be given to the results obtained

pointing out the critical aspects in development. For what concerns the design loop, preliminary trade-off has been performed. Sensitivity studies to different design parameters, focusing both on regenerative circuit and injection characteristics, have been carried out. The final configuration after a TPM trade-off has been selected and analysed.