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DESIGN TOOLS FOR LOW-COST SOLID FUEL RAMJET STATIC TEST PLANNING AND EXECUTION

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Abstract: The Solid Fuel Rocket Propulsion System (SFRJ) is a fundamental technology in a wide range of aerospace applications, notably in missiles and other flight platforms. Its effectiveness is attributed to several factors, among which stand out its mechanical simplicity, high efficiency and reduced operational cost. The mechanical simplicity of the SFRJ is one of its most striking features. Unlike more complex propulsion systems as, for example, the traditional jet engines, the SFRJ does not require sophisticated moving components such as turbines or compressors. This characteristic not only simplifies the system's design but also substantially reduces the likelihood of mechanical failures, making it a reliable option for a variety of applications. Despite its simplicity, the SFRJ is capable of generating a significant amount of thrust from a relatively small amount of fuel. This is partly due to its high regression rate, which refers to the rate at which the solid fuel burns and decomposes, converting into exhaust gases and providing propulsion to the rocket. Paraffin, the primary fuel used in the SFRJ, is particularly effective in this regard, offering controlled combustion that propels the rocket consistently and predictably. It can be considered atractive for researchers due its low cost and high availability in the market, contributing to the economic efficiency of the SFRJ and making it an accessible option for a variety of projects and programs. Additionally, paraffin has a low risk of explosion, making it safe to handle and store, and its high regression rate allows for effective control of the rocket's thrust. To enable ongoing research and development of the SFRJ, a low-cost test bench has been developed in University of Brasilia (UnB). This test bench is equipped with a heat regenerator, air reservoirs, a flow control valve, and a series of pressure and temperature sensors. These components are essential to provide an efficient platform for conducting tests and experiments with the SFRJ, allowing engineers and researchers

to study its performance under a variety of conditions and scenarios. Experimental results validated in theoretical fundamentals have demonstrated that the test bench satisfactorily meets the necessary requirements for ramjet testing. In conclusion, the Solid Fuel Rocket Propulsion System (SFRJ) is a essential technology in the aerospace industry, thanks to its mechanical simplicity, efficiency, and reduced operational cost. With the ongoing development of low-cost test benches and the improvement of paraffin-based fuels, it is expected that the SFRJ will continue to play a crucial role in advancing rocket propulsion technology.

Keywords: ramjet, packed bed, convection, low-cost bench, solid fuel.