

IAF SPACE PROPULSION SYMPOSIUM (C4)  
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DESIGN OF A VERTICAL TEST BENCH FOR HYBRID ROCKET MOTORS WITH TVC TESTING  
CAPABILITIES**Abstract**

A static test bench is required to test and qualify a rocket motor. A vertical test bench provides testing capabilities of more complex propulsion system arrangements, such as operating the motor with the combustion chamber, feed, power supply and control systems assembled in launching position, giving a better comprehension of its functionality. Besides, it is suitable for the validation of the motor's TVC (Thrust Vector Control). However, in general, it is a complicated and more expensive structure, and it brings some inherent risks. The Chemical Propulsion Laboratory (CPL) of the University of Brasília has many years of testing experience with rocket motors horizontally. The necessity of having such a type of structure to validate ongoing and future projects and the laboratory level of development requires a simple, feasible, safe, and low-cost design. Thus, the bench structure and its auxiliary components are easily assembled and disassembled, reducing maintenance complexity, and the motor installation on the bench is uncomplicated. In addition, a load cell pattern and the interface between the motor and the bench permit future TVC projects, since such setup allows the measurement of the thrust vector components. Also, high safety factors were used to guarantee safe procedures to the operators, increasing its reliability. CAD and CAE tools to aid in the development were implemented, improving the components' arrangement and assuring structural integrity for a wide range of laboratory scale motors. The reached design attained the requirements of testing rocket motors. Additionally, it endures high stresses, stability and mechanical vibrations, to ensure the users' safety and reliability during data acquisition. Its simplicity allows it to be easily transported or to be built in various laboratories. Furthermore, the feed, thrust control and ignition systems, already designed at the CPL, can be adapted in a simple way to fit on the bench.