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THE INFLUENCE OF UNION DESIGN IN THRUST MEASUREMENT OF A TO D CATEGORY
ROCKET MOTOR IN AN AMATEUR TEST BENCH. A CASE STUDY

Abstract

In the development of a rocket it's of great importance to know the characteristics and behavior of its motor, whether it is a professional or amateur rocket. While testing these rocket thrusters, the structural rigidity of the test bench can affect these measurements in a significant way, and mislead the whole development of the project. In the course of this research, we will cover this effect in a case study: the design, calibration and validation of a small rocket motor test bench.

In this research, two different union design approaches will be compared in order to confront their influence on the overall structure and thus, to be capable of selecting the best proposal in terms of reliability, fabrication cost and simplicity of the fabrication process. The two design approaches are: a removable union (RUD) design based on bolts and nuts, and a fixed design (FUD) based on a welded union. The structure is made of EN AW-2024 aluminum.

The method to accomplish this study was purely experimental, testing several commercial rocket motor graded between A and D category. The thrust force was measured by a parallel beam load cell TAL220. The data was collected from this load cell through an Arduino UNO interface with a precision of 0.001 kg. First, the RUD approach was tested, with an amount of motor units sufficient enough to ensure there were no interferences. After this first stage, all unions were welded using TIG welding with Tungsten-Thorium electrode. The process used in for testing the RUD in the first stage will be repeated for the FUD testing, under the same conditions. Also, in order to be able to compare the economic and complexity aspect of each approach, time and total costs of each fabrication process were noted.

Our expectations on the results of this research are that the FUD approach provides more precise data from the motor testing after comparing with the manufacturer's characteristics. However, taking into account the cost and complexity of the TIG welding, the RUD approach will arise as a better choice for the purpose of this test bench, that is: to provide an accurate enough description of the model rocket motor without great cost in products and manufacturing.