Group R : Design of a Modular Bench-Scale Rocket Engine Test Stand for the McGill Rocket Team

Client: McGill Rocket Team

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The McGill Rocket Team (MRT) aims to reach higher apogees, requiring more powerful engines and increasingly complex and costly testing procedures. To address this, a bench-scale rocket engine was developed to generate rapid and scalable data. This capstone aimed to design a portable, modular test stand adapted to these engines.

The proposed design replicates key flight conditions through a vertical downward-firing configuration incorporating a symmetrical prismatic deflector plate to ensure anchoring and stability. The system dimensions were defined based on transportation and operational constraints. Structural and plumbing components were analyzed using hand calculations and finite element analysis, with a minimum factor of safety of 5 under a nominal thrust of 1 kN and of 4 on the maximum operating pressure of 1000 psi.

The test stand was manufactured, assembled, and instrumented, followed by a series of validation tests including structural load and tipping tests, hydrostatic pressure testing of the tanks, leak testing, and oxygen cleaning of the plumbing. Final validation was performed through cold-flow and hot-fire testing. Initial results demonstrate the feasibility of the concept and its suitability for rapid testing. Manufacturing challenges were encountered with the deflector plate due to mold failure, and redesign is planned as future work.