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STUDENT TEAM DEVELOPMENT OF BIPROPELLANT ELECTRIC FEED SYSTEM FOR 2.2KN ISOPROPYL ALCOHOL/LIQUID OXYGEN ROCKET ENGINE

Abstract

This paper focuses on the development of a liquid propellant electric feed system (EFS) consisting of two independent pumps to deliver high-pressure propellants to a liquid rocket engine from onboard low-pressure composite propellant tanks. Portland State Aerospace Society (PSAS) is developing a very low weight composite airframe liquid propulsion launch vehicle (LV) capable of reaching an altitude of 100 km. This LV will be powered by a liquid engine running on isopropyl alcohol (IPA) and liquid oxygen (LOX). The EFS is a necessary flight component allowing for maximum optimization in weight reduction through the use of low pressure composite propellant tanks. Development for the EFS began with external research regarding low flow high head pump design to better understand the requirements and challenges involved with these types of systems in order to best allocate available resources. To reduce prototyping costs, in-house manufacturing and commercial off the shelf (COTS) parts were prioritized. Task distribution over the nine month project timeline began with developing a working IPA pump design as a collective team. Next, the team was divided up to allow manufacturing of the IPA prototype to run parallel with designing the LOX pump using lessons learned from the previous design and research. All proven final prototype designs were then outsourced for final manufacturing to increase our overall production efficiency. The objective of this report is to discuss the overall performance of the individual pump designs and how they operate as a combined unit. This will include reviewing the output pressure and flow rate capacities, pump efficiencies, electrical motor control and selection, and the overall success to meet the customer requirements. In depth discussion will detail system performance improvement for future iterations as PSAS scales their liquid engines to meet the goal of a 100km rocket launch. The final conclusion summarizes the overall effectiveness of the final project and the contribution it will provide to further the capabilities for Portland State Aerospace Society.