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CRYOGENIC PUMP DESIGN AND TESTING FOR HYBRID ROCKET APPLICATIONS

Abstract

In hybrid rockets, propellant feed system needs to deliver liquid oxidizer with a specific pressure in order to satisfy required flow rate into combustion chamber where solid fuel is placed. The liquid oxidizers which are used in hybrid rocket applications may vary but the general tradition is to use cryogenic oxidizer due to their higher Isp (specific impulse) compared to storable oxidizers. There are two main ways to construct cryogenic oxidizer feed system in hybrid rocket propulsion; pressure-fed and pump-fed. Pressure-fed systems may provide cost-effective and simple solution; however, since applied pressure on feed lines and tanks are high, heavier tanks, valves and other elements are needed for the structural integrity. For the latter method, only small part of the feed line is exposed to high pressure, this results in lighter tanks and feed line elements. Therefore, pressure-fed systems are used for small scale launch vehicles while pump-fed systems are employed for higher "ΔV" missions in which hybrid rockets with higher performance and combustion pressures are required. Due to the advantages of pump-fed hybrid rocket system, the design and CFD analysis of small LOX (liquid oxygen) pump prototype that delivers 1 kg/sec will be discussed in this paper. Performance tests will be conducted with both water and LOX using suitable electric motor to drive the pump and the results of these tests will be presented and compared with CFD results. Finally, the electric motor driven LOX pump system is planned to be used in hybrid rocket motor hot firing test.