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NOFBX^{TM}: A NEW NON-TOXIC, "GREEN" PROPULSION TECHNOLOGY WITH HIGH PERFORMANCE AND LOW COST

Abstract

According to current projections, approximately 85 spacecraft will be launched into space each year over the coming decade almost every one on which will carry a propulsion system employing hydrazine propellant. This ubiquitous status has been achieved by hydrazine despite extreme toxicity, carcinogenic properties, corrosiveness and high cost – both nonrecurring and in operational overhead. The 1 recommendation from the 2010 CRASTE study (a joint NASA/USAF/FAA Commercial Space Task Force) for commercial space development was to provide an affordable, replaceable, nontoxic alternative to hydrazine that commercial developers can easily handle. More recently, both the United States and Europe have been actively seeking alternatives by contributing to the advancement of the technology through demonstrations. Innovative Space Propulsion Systems (ISP Systems) is now developing and demonstrating NOFBX^{TM} monopropulsion systems and components whose performance significantly exceeds monopropellant hydrazine systems and is even comparable to the bestperforming stateoftheart bipropellant systems.

NOFBX^{TM} is a nitrousoxidebased monopropellant technology, developed under NASA and internal research and development funding, that offers the potential for dramatic benefits over current storable liquid propulsion technology for spacecraft reaction control and maneuvering. Important characteristics of the propellant include being nontoxic and environmentally benign – both to a much higher degree than other "green" propellants seeking to compete with hydrazine. Furthermore, NOFBX^{TM}'s relatively high vapor pressure allows it to be selfpressurizing in many applications, resulting in a single fluid system instead of two or three fluids for monoprop or biprop hydrazine respectively. This simplification to spacecraft propulsion subsystems means fewer failure modes, higher reliability, lower mass, lower power and ultimately, lower cost. NOFBX^{TM} may also be stored over a very wide range of temperatures (70 C to ¿+100C). Its constituents are widely available, inexpensive, safe to handle, and the effluents from combustion are non toxic with water as the only condensable.

NOFBX^{TM} thrusters have been demonstrated in the 0.4 N to 450 N (0.1 – 100 lbf) thrust range, with measured specific impulse (Isp) performance of up to 325 seconds. Thrusters are restartable, deeply throttleable, and display low acoustic signatures. Importantly, the cost of these thrusters will be substantially lower than comparable hydrazine components. ISP Systems is currently preparing a flight demonstration to the ISS in 2013, to establish first flight heritage and to demonstrate a pumpless propellant transfer concept. This paper will describe NOFBX^{TM} characteristics and applications, provide status of the flight demonstration, and outline future opportunities and plans.