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A Comprehensive Performance Analysis of Nitrous Oxide as a Rocket Propellant and Gas Generator Oxidizer

Mark C. Grubelich

Jennifer D. Lindblom

While historical use of nitrous oxide (N_2O) for propulsion applications dates back to 1934, N_2O has been a neglected rocket propellant oxidizer in the field of propulsion because of modest performance in comparison with traditional fuel-oxidizer combinations. However, N_2O does have unique merits with application to “green” propulsion systems, academic studies and as a clean warm/hot gas generator propellant. A comprehensive performance data set on N_2O as a rocket propellant oxidizer was found to be lacking in the literature. This paper addresses this lack of centralized data and provides a systematic review of nitrous oxide with numerous traditional and non-traditional fuels in both bi-propellant and hybrid propulsion systems with and without metallization. Potential hypergolic systems are identified as are novel gas generation systems. Performance in terms of specific impulse, density specific impulse, vacuum impulse, density vacuum impulse and flame temperature is reported over a range of mixture ratios. This work allows the propulsion system or gas generator designer a convenient tool to rapidly assess the potential application of N_2O in propulsion system design and trade studies by providing a single comprehensive data source. Additionally novel N_2O fuel combinations are identified and recommendations are made for the further experimental study.