



WARM GAS PRESSURIZATION OF PROPELLANT TANKS

OVERVIEW

Traditional bi-propellant tank pressurization methods utilize ambient temperature gas storage expanded through regulators for tank pressurization. Short duration burns such as those anticipated for launch from the Mars surface result in significant temperature drop in the pressurant gas. This low temperature gas is less efficient for tank pressurization because of the increased density at reduced gas temperatures. It has been estimated that the mass of helium pressurant and helium storage tanks could approach 20% of the total system dry mass for a Mars surface launch. It has further been estimated that approximately 35% of this dry mass could be eliminated through the use of a warm gas pressurization system, which does not require propellant tank diaphragms or bladders.

TEST APPARATUS AND PROCEDURE

WSTF has developed the system to allow testing of warm gas propulsion systems utilizing a tridyne gas mixture. Tridyne is a dilute mixture of hydrogen and oxygen in a helium base, which is passed over a catalyst bed and heated by the catalyzed reaction of the hydrogen and oxygen. This test system can be modified to test pressurization systems for hypergolic or cryogenic tank pressurization tests that will utilize tridyne gas mixtures for propellant tank pressurization. The test system has the capability to expel actual propellants from propellant tanks into catch vessels, measure temperatures and pressures in the pressurization and propellant tanks, and allow gas and propellant samples to be taken for analysis. Rocket engine or system level testing can also be conducted in the White Sands Test Facility utilizing warm gas pressurization systems.

Thermal conditioning of the entire system is possible to simulate the ambient conditions required for the test. Initial design point is to simulate the Mars average diurnal temperature of -40°C .

TEST RESULTS

Test results will include analysis of both propellant and pressurization system thermal effects, and the chemical analysis of pressurant gas and liquid propellant.

APPLICATIONS

- Technology development for Mars sample return missions
- Other short duration tank pressurization applications where relatively short expulsion periods result in significant decrease in pressurant temperatures, and where system dry mass is critical

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