Paper ID: 45076
oral

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Technologies for Future Space Transportation Systems (5)

Author: Mr. Charles Lauer
Rocketplane Global, Inc., United States, clauer@rocketplane.com

DEVELOPMENT AND TESTING OF AN AERIAL LIQUID OXYGEN TANKER SUPPORT AIRCRAFT TO ENABLE LOW COST LEO LAUNCH SERVICES

Abstract

Rocketplane Global (RGL) is continuing its engineering and development effort for its Mach 12 spaceplane design, based on a 20 year legacy of systems engineering for high Mach suborbital spaceplanes. The first stage reusable launch system is capable of delivering up to 2,000 kg to a 800 km polar orbit and can deliver over 2,500 kg to the ISS orbit. A key enabling technology for this system is the use of a KDC-10 tanker aircraft to transfer the majority of the propellant load to the spaceplane once the vehicle is in the air and flying at normal subsonic jet speed. The tanker carries the 64,000 kg of LOX plus the kerosene fuel. By taking off "light" with only a small fraction of the fuel and oxidizer required to pre-chill and condition the tanks and lines, and then transferring this propellant load in flight, the vehicle dry mass fraction challenges are greatly reduced. This in turn enables the disruptive reduction in launch price to less than $20 million for a 2 ton LEO satellite. While the transfer of large volumes of kerosene from a tanker to a receiver aircraft has been a routine TRL9 level operation for decades, the midair transfer of large volumes of cryogenic fluid at high flow rates between two aircraft has not been done before. However, such transfers using long flexible vacuum jacketed hoses are a routine part of ground operations for launch vehicles. RGL has proposed a Space Act Agreement with the Kennedy Space Center Cryo Lab to develop and test its aerial LOX transfer system on the KSC cryo test facilities and demonstrate the transfer process using LN. Subscale testing using a 3cm VJ hose will be conducted first to validate the entire transfer sequence, followed by a full scale test using a 12cm VJ hose at the full 800 gpm flow rate. The LN test stand work is intended to raise the system to TRL 7, and will be followed by aerial testing in the KDC-10 using LN first, and then operational ground and aerial testing using LOX. The aerial LOX transfer development and testing program is planned to reach TRL8 within 3 years in order to provide commercial tanker support service to the RGL launch system the following year. This paper will describe the RGL systems development and testing program to achieve operational capability for high volume aerial cryogenic propellant transfer.