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

THE GROUND AND FLIGHT TEST PROGRAM FOR THE XP SUBORBITAL SPACEPLANE

Abstract

The XP spaceplane now being developed by Rocketplane Global (RGI) is a fully reusable suborbital vehicle about the size of a mid-sized business jet. It takes off and lands from conventional runways using J-85 afterburning turbojets and ascends to a 13 km altitude under airbreathing thrust before igniting its LOX / kerosene rocket engine for the ascent to space. After a 70 second main engine burn the XP has accelerated to Mach 3.5 and climbed to about 50 km altitude at rocket engine cut-off. Thereafter a ballistic coast carries the vehicle to its 104 km apogee and back to atmospheric re-encounter at 50 km again.

Key elements in the vehicle development program to assure safety, reliability and mission success are an extensive ground and flight test program based on decades of industry experience in the development of high performance aircraft. The XP spaceplane, while the size of a typical business jet, is technically much more similar to a new fighter plane with fly-by-wire systems, electromechanical actuators and an integrated flight computer and flight control hardware and software suite. The rocket propulsion systems are heavily instrumented to provide continuous performance and safety data from initiation of the start-up sequence to engine shutdown, and have redundant safe-mode shutdown procedures in the event of any rocket engine anomalies.

All of the critical flight operations and safety systems in the XP spaceplane will first be tested on the ground in high fidelity hardware-in-the-loop test stands and systems. The Environmental Control and Life Support Systems (ECLSS) will utilize a dedicated test chamber facility to simulate failure modes and emergency procedures. Computerized flight control systems will be validated in an "Iron Bird" ground test article before the first flight.

Once the prototype vehicle has completed the integration process an extensive flight test program is planned. The flight envelope is expanded in very small increments starting with engine start and taxi tests and proceeding through takeoff, landing, gear retraction and deployment, full afterburner jet climb and supersonic transition while under jet power. Once the airbreathing flight envelope has been validated, rocket powered flight tests will commence. The flight envelope will be expanded from a few seconds of rocket thrust to the full 70 second burn duration in small increments, with all abort modes being validated in flight.

This paper will describe the details of the XP spaceplane ground and flight testing program.