

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Small Launchers: Concepts and Operations (7)

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## LOW COST ACCESS TO SPACE BOOSTER AIRCRAFT

**Abstract**

This proposal concerns the design of a low-cost, high availability, reusable high-performance jet aircraft. It will be used as the first stage of an air launch system, capable of launching up to 1500kg into low earth orbit, to be titled Pioneer, an Affordable Space Booster Aircraft (ASBA). The paper is an adaptation of a project submitted to the 2010/11 American Institute for Aeronautics and Astronautics (AIAA) Undergraduate Individual Aircraft Design Competition, which was awarded 1st place.

The costs associated with conventional space launchers, as well as the demands for small space payloads, are ever increasing. The rising demand is partly due to increasing capabilities of small satellites, with the growing demand creating a market for low cost space launch systems.

From a review of the literature, it was found that there are many possibilities for the design of such a system, and the air launch concept holds many benefits over traditional launch systems, most notably cost savings, higher availability and lower energy requirements. Due to findings from the background research, the project scope was slightly expanded to investigate differing mission profiles than those given in the design competition Request for Proposal (RFP).

The aircraft was designed to perform two set mission profiles, a launch mission and a ferry mission. The final design was completed for a primary launch mission that had been modified from the mission set in the RFP document. This was due to the possible benefits for the launch vehicle performance outweighing the effect of the increased weight of the aircraft for the modified mission. This design performs well against the performance constraints set in the RFP, and also gives an acceptable range for a ferry mission, highlighted as a key benefit and advantage for air launched space payloads over conventional ground launched rockets. Finally, recommendations for further work are given, including more structural and systems design investigations, and also plans for eventual certification of a final detail aircraft design.

Pioneer meets or exceeds all of the requirements set in the RFP, including a launch mission that has been further optimized to increase the performance of the launch vehicle (LV). The primary launch mission was modified to include a launch at 50,000ft at Mach 1.8 following zoom climb at 30. The ferry mission for this configuration has a range of 3075 nautical miles.