IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Safe Transportation Systems for Sustainable Commercial Human Spaceflight / Small Launchers: Concepts and Operations (Part II) (9-D6.2)

Author: Mr. Dawid Cieslinski
Institute of Aviation, Poland, dawid.cieslinski@ilot.edu.pl

Mr. Adam Okninski
Institute of Aviation, Poland, adam.okninski@ilot.edu.pl
Mr. Michal Pakosz
Institute of Aviation, Poland, michal.pakosz@ilot.edu.pl
Mr. Tomasz Noga
Institute of Aviation, Poland, tomasz.noga@ilot.edu.pl
Mr. Tobiasz Mayer
Institute of Aviation, Poland, tobiasz.mayer@ilot.edu.pl
Mr. Damian Kaniewski
Institute of Aviation, Poland, damian.kanies@gmail.com
Mr. Wojciech Florczuk
Institute of Aviation, Poland, wojciech.florczuk@ilot.edu.pl
Mr. Bartosz Bartkowiak
Institute of Aviation, Poland, bartkowiak.bw@gmail.com
Prof. Piotr Wolanski
Polish Academy of Sciences, Poland, wolanski@itc.pw.edu.pl
Dr. Pawel Surmacz
Institute of Aviation, Poland, pawel.surmacz@ilot.edu.pl

ILR-33 AMBER" ROCKET - A PLATFORM FOR MICROLAUNCHER SYSTEM TECHNOLOGY DEVELOPMENT

Abstract

With the increasing need for individual launch services for small satellites, plenty of microlauncher concepts are being elaborated within the space sector worldwide. As it is an early phase of the process and only a few offers are available, there is still an opportunity for newcomers to participate in the emerging microlauncher market.

ILR-33 "Amber" rocket is the latest achievement of Warsaw Institute of Aviation. The main goal of the "Amber" rocket project was to develop a highly scalable, cost-effective platform for in-flight validation of microlauncher technologies. Efficient green propellant hybrid rocket technology is to enable conducting suborbital missions for altitudes up to 100 km. ILR-33 provides up to two minutes of microgravity conditions (10^{-3} to 10^{-6} g). All subsystems including launch support ground facilities have been developed in-house. The first flight, being a successful demonstration, was held in October 2017. Due to the test range restrictions and safety constraints, a flight with a 15 km ceiling was performed. Limited performance was achieved by reducing the mass of the oxidiser in the tank. The main hybrid motor utilises 98% hydrogen peroxide (High Test Peroxide) as oxidizer and polyethylene as fuel, with burn time of 40 s. The 2017 flight was the first in-flight demonstration of a vehicle using such high concentrations of hydrogen peroxide as oxidiser worldwide. Telemetry data is discussed.

This paper is to present the results from the first flight test and to focus on practical possibilities of up-scaling technologies with focus on vehicle propulsion. The paper discusses a concept of a microsatellite launch vehicle enabling delivering small payloads to 700 km Sun-Synchronous Orbits. Various technology trade-offs are presented with focus on decreasing non-recurring and recurring costs. Analyses of current TRLs and national development capabilities are provided. The paper contains comparisons between various system architectures with Rough Order of Magnitude cost estimation. The technology development roadmap is shown and the proposed consumer-orientated service is described.