

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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## FIRST TEST FLIGHT OF A REUSABLE SUBORBITAL PERUN ROCKET.

**Abstract**

PERUN is a reusable suborbital rocket designed to deliver 50 kg of scientific and commercial payloads to altitudes of up to 150 km. It is developed by a Polish company SpaceForest which aims to reduce the cost of suborbital flights by making PERUN entirely reusable. The development of the PERUN rocket has started in mid-2018 and is almost finished, as PERUN is going to be launched for the first time during one of the three launch windows between 26th April and 26th May 2023. The launch will take place in Central Air Force Training Ground which is located on the coast of the Baltic Sea in Poland. On 14th February 2023 a wet dress rehearsal at the Central Air Force Training Ground was completed. It involved a launch tower setup, entire rocket assembly, oxidiser tank filling and connection test between the on-board computer and the ground station. All of these tests were completed successfully, what allowed SpaceForest to proceed with final preparations for the flight.

In this flight PERUN will achieve an altitude of up to 50 km and a maximum speed corresponding to Mach number greater than 2.5. PERUN is powered by a hybrid rocket engine called SF-1000 which utilises nitrous oxide as an oxidiser and paraffin with additives as fuel. The SF-1000 is equipped with an innovative Thrust Vector Control (TVC) system that controls the rocket during ascent. One of the main goals of this test flight is to verify the flight performance of the SF-1000 engine and assure the correct

behaviour of the control system. The rocket is recovered with a two-stage parachute system. The first parachute stage uses a supersonic ballute during re-entry phase and for landing a conventional parachute is deployed. After the successful flight the rocket is recovered from water.

This paper presents the expected mission profile and preparations of the PERUN rocket. These expectations will be compared with a real mission outcome that will be known by the end of May 2023. It also describes the rocket configuration for this flight and how it differs from the configuration intended for a suborbital flight. During its nominal flight PERUN will be able to provide up to 5 minutes of microgravity and access to high-speed testing environment. The results of these test flight will be used to validate the performance of PERUN before the start of commercial operation at the end of 2023.