

SPACE PROPULSION SYMPOSIUM (C4)  
Propulsion Systems II (2)

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## DEVELOPMENT OF A HYBRID ROCKET ENGINE FOR THE STRATOS II ROCKET

**Abstract**

In 2009 Delft Aerospace Rocket Engineering (DARE) broke the European altitude record for amateur rockets with the launch of Stratos I to 12.5 km. Currently, DARE is developing its successor, the Stratos II rocket, which is designed to reach 50 km altitude. To overcome the limitations from the relatively low specific impulse of 110 to 130 seconds of DARE's current solid rocket motors, a team for the development of an alternative propulsion concept has been established. In 2010 a group of international students within DARE started the DAWN project focusing on the development of a N<sub>2</sub>O-sorbitol hybrid powered engine for Stratos II.

As part of the development, various fuel recipes have been investigated experimentally. For this a battleship motor has been developed. Also work has started on a small hybrid engine capable of launching Stratos II to 1 km altitude. The design of this engine is unique in that it includes an all composite structure, with the skin of the oxidizer tank and the fuel casing as load carrying structure.

This paper presents the results of the research on the fuel recipes, consisting of the investigation on the regression rate and burn stability of sorbitol with varying amounts of opacifying additives, and the comparison of these results with tests applying paraffin. Furthermore we present the modular design of the flight engine, and the systems engineering approach used to assure that the design meets the safety requirements for launch on a professional launch site. For the flight engine, we discuss the various components, including the composite tank with a liner that is compatible with the cold oxidizing liquid,

the feed system section with an in house developed and tested pyrovalve, and the composite combustion chamber with a liner that is compatible with the hot combustion gasses.

Despite the many challenges faced by the team to develop this engine in just 1.5 year, the successful realization of this engine provides great opportunities for innovation, and brings DARE one step closer to space.