# Aerospace Europe Conference 2023
# Joint 10th EUCASS – 9th CEAS Conference

Abstract #XXX *(to be filled by the organizers)*
Preferred Topics: PROPHY
Corresponding author: STARK Ralf
e-mail of corresponding author: ralf.stark@dlr.de
Type: Oral
Status of corresponding author: Regular


**Title**

# Design Study of a 30kN LOX/LCH4 Aerospike Rocket Engine for Lunar Lander Application


## Authors

*Ralf Stark [1]*, Sebastian Bartel [2]*

** Corresponding author*
*[1] German Aerospace Center, Langer Grund, D-74239 Lampoldshausen, Germany, ralf.stark@dlr.de*
*[2] FH Aachen - University of Applied Sciences, Bayernallee 11, D-52066 Aachen, Germany*



## Abstract

In the frame of ESA's Terra Novae exploration vision, the concept study Large European Logistics Lander (EL3) was conducted. The mission scenario includes e.g. lunar base equipment and energy supply, in-situ resource provision and production, and sample returns.

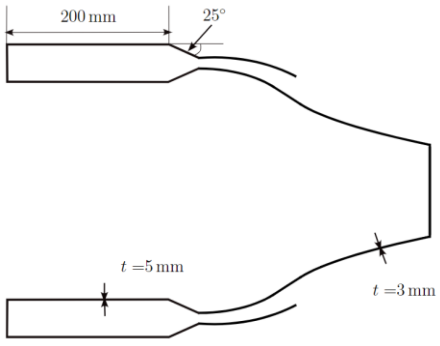


Figure 1, Sketch of an aerospike engine with a truncated non-ideal plug.

To drive the vehicle, beside conventional rocket engines (whether as a single main engine or in a clustered configuration of small engines), unconventional engines based on the aerospike nozzle concept are of interest. Such engines feature a reduced overall length and promise an increased thrust to weight ratio.
From EL3 related literature a need of 30 kN thrust can be derived. Considering the potential of in-situ produced propellants, the combination of LOX/LCH4 is promising. To address the awaited variable mission profiles, throttlability has to be considered as well. In case of a single engine, the thrust reduction can be achieved by reducing the mass flow, and for a cluster by switching off some of the engines. Hence, studying a cluster of six smaller thrusters, each with 5 kN of thrust, is reasonable.
Within the conference contribution a single main engine and a cluster of six smaller engines are studied initially, concerning the overall length, the relative engine mass and the related total propellant mass impact.
The main focus of the presented study is on the aerospike nozzle design. Typically, an aerospike nozzle is designed as an ideal contour, resulting in its eponymous spike. The nozzle is truncated to a certain extend and the resulting circular base or rather wake section experiences an additional pressure, resulting in thrust.
Here non-ideal aerospike nozzles are designed, where no 'spike' but a 'stump' is obtained. In both cases mass flow and impulse are identical, but the additional thrust gain by truncation differs.

The suggested conference contribution introduces to the topic (including literature), presents the postulated launcher's velocity requirement and 4 sets of related engines, compares and evaluates the derived data, and concludes practical recommendations.