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DEVELOPMENT OF RE-USABLE LIQUID PROPULSION ROCKET ENGINES (LOX / LNG) BASED ON TURBO PUMP FED TRANSPIRATION COOLED, CERAMIC THRUST CHAMBERS

Abstract

The development of high performance, but affordable and preferably re-usable propulsion systems is a key component to enable commercial space flight.

An overview of the technologies under development at Black Engine Aerospace and WEPA-Technologies in collaboration with German Aerospace Center (DLR) will be given and does encompass thrust chambers and turbo pumps. A turbo pump fed, 60 kN thrust, technology demonstrator (75 bar chamber pressure) using LOX / Liquified Natural Gas (LNG, min. 95 % methane) will be presented in detail.

- Liquid propellant engines used are based on transpiration cooled, advanced ceramic thrust chambers. This technology has been thoroughly developed and qualified for example by DLR and shows a high potential of multiple re-usability. (WEPA in 2016 did receive a license to commercially exploit DLR's technology.) Due to the segmented design and avoidance of traditional metallic structures manufactured by electrodeposition, fast-track development of thrust chambers is possible. The use of LNG – instead of rocket-grade kerosene - as fuel component results in several advantages at the engine- and overall system level crucial to re-usable and lower cost propulsion units:

- increased cooling capability of LNG enabling re-usable thrust chambers

- no deposition of solids caused by cracking of fuel and avoidance of subsequent blocking of cooling channels or turbine blades

- increased overall performance; facilitated design of stage by full cryogenic system (common bulkhead of tanks; less stringent isolation requirements)

- Turbo pump units using innovative ceramic journal bearings in order to tackle one of the most demanding issues with respect to their re-usability: while the development of fluid bearings is described in the literature since a long time, the use of ceramic fluid bearings enabling full surface area feed of propellant is innovative and very promising with respect to long life and multiple re-usability of bearings. (Bearings are being developed in collaboration with DLR and Kaiserslautern University of Technology (Germany)).

The status of design- and experimental activities will be presented.