IAF SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic Air-breathing and Combined Cycle Propulsion (9)

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KEYNOTE: TEST COMPLEX M11: RESEARCH ON FUTURE ORBITAL PROPULSION SYSTEMS AND SCRAMJET ENGINES

Abstract

Test Complex M11 is a part of the Institute of Space Propulsion of the German Aerospace Center (DLR) at the European Research and Test Site for Chemical Space Propulsion Systems in Lampoldshausen. Test Complex M11 is home of the Department of Propellants, where research and test activities are focused on advanced storable propellants for satellites and orbital propulsion systems to replace hydrazines in the whole operational range. Furthermore hypersonic flows, combustion and cooling concepts for SCRamjet engines are investigated.

The Test Complex M11 altogether includes six testbeds. Four of these testbeds are permanently assigned for specific tasks while the other two, the so called student's testfield, can be converted in a short time to adapt to requested parameters.

Testbed M11.1 is equipped with a hydrogen-oxygen air vitiator delivering up to 5 kg/s at 1500 K. At M11.1 research on Ramjet- and SCRamjet-engines is conducted, especially on effusion-cooling concepts of structural elements at supersonic flows.

M11.2 is the high-altitude testbed where orbital propulsion systems are investigated at relevant conditions. Vacuum levels below 5 mbar can be kept for several minutes with thrusters up to 250 N. The testbed is connected to the central hydrogen, oxygen and nitrogen supply with 200 bar. Tempered pure water and a hydrocarbon and nitrous oxide infrastructure is available. A variety of propellants can be tested varying from pure monopropellants via premixed explosive-based monopropellants to hypergolic bipropellants with short turn-around times.

At testbed M11.3 fundamental research on different hybrid propellants is conducted. Especially combustion efficiency, combustion performance and burning behavior are in focus. In the following steps these propellants can then be test fired at testbed M11.5/2 in hybrid rocket motors with thrusts up to 10 kN.

M11.4 is designated to combustion and spray tests with gelled mono- and bipropellants.

At M11.5/1 and M11.5/2 hybrid rocket motors are tested and propulsion systems based on hydrocarbons and nitrous oxide in premixed state and bipropellant modes are investigated. A physical-chemical

laboratory is also part of the Department of Propellants. This close collaboration between test facilities and laboratory offers propellant synthesis, tests, analysis and modification in a short time.

This paper will give a detailed overview over the Test Complex M11 and will present current research topics at the particular testbeds.