DLR

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Test Bench Complex M11

DLR site Lampoldshausen

brief description

Research and technology development work in the field of novel propellants for rocket and ramjet engines is carried out at the M11 test stand complex and in the associated physical-chemical laboratory at M3.
The test bench complex consists of four test positions (M11.1, M11.2, M11.3, M11.4) and the test field M11.5.

goals

- Development of advanced green propellants for the replacement of storable propellants such as hydrazine
- Investigation of the flow, spraying and combustion processes of gelled propellants
- Investigations into the improvement of combustion efficiency and instability processes of hybrid rocket engines
- Investigation of flow processes in ramjet engines

involved

ArianeGroup, ESA, HyImpulse, Fraunhofer Institute for Chemical Technology (ICT), MBDA Bayern-Chemie, FOI, ECAPS, FOTEC, universities

applications

Research and development work in the field of known and new types of propellants for
rocket and ramjet engines.
Engine tests,
development, production and physical and chemical analysis analysis of novel propellants and propellant combinations.

perspectives

- Safe and efficient use of green rocket fuels
- Cost reduction in testing, refueling and operation of spacecraft
operation of spacecraft
- Expanding the understanding of combustion processes in rocket and ramjet propulsion systems

facts and figures

- Built in 1966
- 200 bar supply for H_2, O_2, N_2, compressed air, additional N_2O available
- 4 Test position in the upper area (M11.1 - M11.4)
- 2 test positions on the test field M11.5
- Physico-chemical laboratory in building M3
- Vacuum test position (M11.2) with ejector system

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Test position **M11.1** is equipped with a hydrogen-oxygen air heater to simulate **scram** and **ramjet** conditions. The air heater generates a mass flow of up to 5 kg/s of hot air at a total temperature of at a total temperature of 1500 Kelvin. At present, investigations into the film cooling of rocket engines are being carried out at M11.1 together with ESA, ArianeGroup and the VKI.

At **M11.2** there is a vacuum test position with a vacuum chamber, pumps and a 2-stage nitrogen ejector system. The injection, ignition and combustion of new types of satellite propellants in experimental engines under vacuum conditions are researched here.

The **M11.3** is used to investigate the combustion and conversion behavior of hybrid fuel combinations. This involves burning various solid fuels with gaseous oxygen. A high-speed camera records combustion and ignition processes through optical access in the combustion chamber. The focus here is on increasing combustion efficiency, combustion rates and the analysis of instabilities.

At test position **M11.4**, gel-like propellants of various compositions are tested. The research focuses on the optical investigation of combustion processes, the miniaturization of combustion chambers, the analysis of additives in the gel and the evaluation of general ignition and combustion properties. Gel-based propellants can offer advantages over solid and/or liquid propellants.

The **M11.5** test field was built in 2013 as an extension to the M11 test bench. Currently, the DLR spin-off HyImpulse is currently testing its newly developed hybrid rocket engine there. Furthermore, the test field is also available to student university groups for test activities as part of the DLR STERN program. At a second test position of the M11.5, there is a DLR test container in which advanced satellite propellants are tested for their suitability in hot gas tests. These novel propellants include so-called „green propellants“.

In addition to the test positions, building M3 also houses the physico-chemical laboratory. This is where new types of rocket propellants, additives and catalysts are developed, produced and analyzed.

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