

# MEETING THE NEEDS FOR RESEARCH AND DEVELOPMENT OF SPACE PROPULSION SYSTEMS IN THE NEWSPACE-ERA - DLR'S TEST COMPLEX M11 AND THE PHYSICAL-CHEMICAL LABORATORY M3

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## Abstract:

Tremendous changes are initiated throughout the space sector during the last decade by opening and commercializing space transport, space missions and all kinds of space-related activities and developments to private companies, start-up's, entrepreneurs or industry cooperations – a transition summed up under the term “New Space”. New Space is directly affecting the development approaches and fundamental ways of thinking in the aerospace sector, leading to new launchers, engines, manufacturing methods and technical solutions thereby shaking up the established industry. Boundary conditions which were of minor importance for a long time -e.g. life-cycle costs - are steeply gaining priority, completely new restrictions are popping up – e.g. manufacturing methods - or heritage manners are being dropped – e.g. space qualification party -. These changes indirectly affect the research, development and testing processes of space components and systems. Enhanced requirements need to be satisfied by the ground test facilities to keep up-to-date and future-proof in the dynamic New Space Era.

Both Test Complex M11 and Physical-Chemical Laboratory M3 are facilities of German Aerospace Center's Rocket Propulsion Test Site Lampoldshausen. Test Complex M11 with its five test beds provides the essential infrastructure and diagnostics for research and developments on thrusters and rocket engines using advanced gaseous, liquid or solid rocket propellants. Engine types include: monopropellants, bipropellants, hypergols, hybrid rockets as well as high-speed airbreathing propulsion (SCRamjets). Laboratory M3 with its comprehensive synthesis and analysis equipment, possibilities for wet-chemistry and gas and liquid analysis methods is the fundamental institution for the tailor-made synthesis, performance and properties analysis of advanced propellants. Both facilities on their own serve highly specified fields in chemical propellants and propulsion systems. A symbiosis of M3 and M11 leads to unique potential in Europe preparing for advanced space propulsion systems.

In the paper the envelope of both facilities will be presented with special focus on requirements for SME's and changing boundary conditions for rocket ground-testing. In addition, research and developments activities of M3 and M11 will be presented and possible future progresses in launcher and in-space propulsion will be discussed.