



DLR site Lampoldshausen  
An overview

Image: ESA



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## **DLR Institute of Space Propulsion**

The German Aerospace Center (DLR) in Lampoldshausen looks back on 50 years of history and experience in liquid and chemical space propulsions.

The global aerospace industry constantly grows and changes. At the same time, the costs of the launcher decrease along with increasing reliability and efficiency. DLR scientists focus their research activities on developing sustainable propulsion technologies. Based on decades of expertise and equipped with unique test stands, DLR Lampoldshausen is indispensable for a safe, flexible and competition-oriented access to space.

DLR in Lampoldshausen uses unique test stands and plants for the testing of rocket propulsions. These installations cover the entire portfolio of test requirements: from the component test to propulsion testing up to the testing of entire rocket stages. The test stands simulate the rockets – in this way, conditions close to real flight mode are achieved. The respective interfaces feed engines with fuels and fluids. The test installations will then measure data as well as manage, control and monitor the engines in current operation.

Research and development represent the basis for advanced technologies in future space-transport systems. This research is conducted on various levels, including experiments in the lab burner and ranging up to real-space propulsion conditions. This is how novel technologies are verified under representative conditions.

### **Hightech synergy**

As early as in 1963, a working group settled in the former premises of the Bölkow Entwicklungen KG. From this area, an ArianeGroup site has emerged currently staffed with 320. They develop, manufacture and test propulsion systems for satellites and space probes.



DLR Forum of Space Propulsion at the DLR site in Lampoldshausen

## **DLR Forum of Space Propulsion**

DLR Forum of Space Propulsion offers the public direct access to the European history of aerospace. A large variety of exhibits demonstrate the excellent competencies all gathered at one site, in particular with respect to the development of altitude simulation systems and to the testing of rocket engines. Partners at a national and international level, representatives from enterprises and the manufacturing industry and, of course, the interested public are invited to the DLR Forum to explore its open-room state-of-the-art exposition area.

### **Contact for visitor groups:**

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## **Obligated to safety**

It is the declared objective of DLR Lampoldshausen to avoid any personal damage and harmful impacts to the environment before and with respect to all its initiatives. This also includes the prevention of hazardous incidents and the limitation of incident impacts in line with the Hazardous Incidents Ordinance, which emerged from environmental protection and requires a smoothly functioning safety management system. Our plants fully comply with the current state of safety technology and are subject to regular auditing by the corresponding authorised monitoring institutions. The safety centre, the plant fire brigade, the first-aid service and the factory safety service help protecting humans, nature and plants in close cooperation with the district administration and the local police authorities.

## High-performance test stands for high-performance engines

The DLR engineers in Lampoldshausen run test stands for the testing of rocket engines, which represents an indispensable prerequisite for the development of drive technologies to maturity and for ensuring their perfect quality. Their core competencies are the operation of altitude simulation plants allowing for propulsion testing under almost real space conditions.

**Findings from data:** the results from the current test campaign for the Vinci® re-ignitable upper-stage engine and the Vulcain®2.1 main-stage engine of Ariane 6 complement the development of the propulsion system design and ensure the quality of such propulsions for flight operation. These tests represent an important milestone for the development of the future European carrier rocket Ariane 6, which is to guarantee an independent access to space for Europe. Its maiden flight is planned for 2020.

Image: ArianeGroup



**Going beyond the limits:** As a complement to the traditional European propulsions with a fuel mix of liquid hydrogen and oxygen, the blend of liquid oxygen (LOX) and methane plays an increasingly important role. DLR scientists are examining these novel fuels at the European research and technology test stand P8 for their suitability under representative conditions. DLR engineers also work on exploring the LOX/methane technology in depth, the target being to develop a cost-effective, high-thrust and reusable rocket propulsion system.

In 2016, DLR Lampoldshausen carried out comprehensive tests for a LOX/methane technology demonstration engine in cooperation with ArianeGroup on test stand P3. Against traditional propulsion technologies, the LOX/methane technology stands out for its reusability and cost-effectiveness.



Image: ESA



## **Test stand technology: indispensable for the future**

DLR engineers design model combustion chambers and entire test stands for rocket propulsions. They conceive, develop, integrate and finally take these plants into operation. Just recently, the upper-stage test stand P5.2 was developed. It is unique in Europe and will enable DLR scientists to test entire upper-stage in the future, including the refuelling and defuelling as well as hot run tests for the Ariane 6 upper stage with the Vinci® engine.

## **Research focused on rocket propulsions**

With their research and development activities, DLR scientists set the basis for reliable and competitive solutions for liquid rocket engines. In this context, particularly advanced, automatable and cost-effective manufacturing processes play a major role such as, for example, 3D printing.

European engineering teams benefit from the advanced test stand technology provided by DLR, conducting practical tests for progressive drive concepts at the research and technology test stand P8. DLR scientists can model life cycles and combustion processes, which is necessary to evaluate novel technologies. The DLR project "LUMEN", will expand the research objectives at the test stand P8 from the component level to the system level of an entire thruster. As part of "LUMEN", DLR scientists will develop and test a pump-operated LOX/methane engine.

## **Green impulses for advanced propellants**

"Green propellants" are also a focal point of attention for DLR Lampoldshausen. The propellant of the future must be environmentally friendly, cost-effective and easy to process by aerospace engines. As a consequence, their research work aims at replacing storable fuels in the long run. Currently, DLR scientists are about to test, analyse and evaluate such novel propellants in engines for their behaviour in terms of combustion, ignition, injection and conveying characteristics.

## Safety, quality and operation technology

For more than 57 years, DLR has been successfully operating the test site for rocket engines in Lampoldshausen. As a consequence, DLR staff has unique competencies when it comes to dealing with vast quantities of hydrogen, storable fuels and the testing of large-scale rocket propulsions. DLR is the competent authority issuing operation authorisations and thus responsible and liable for safe operations.

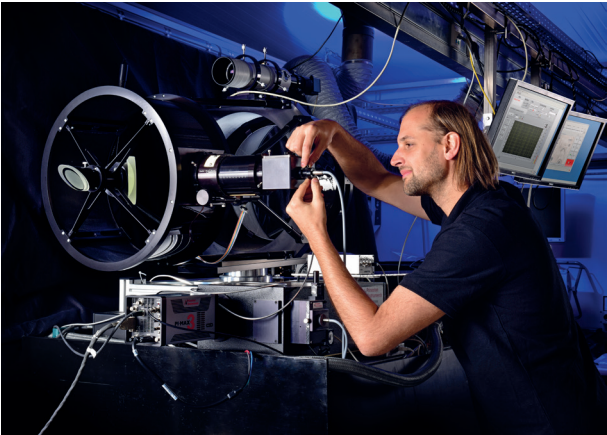
The big market success of the European Ariane programme is basically a result of the increased quality and safety requirements for space shuttles. The tendency towards a European and international standardisation of processes and the adherence to obligatory provisions entailed the setting up of a Quality Management System (QMS) following the currently applicable German standard DIN EN ISO 9001. The QMS supports test stand operations in all project stages.



DLR safety engineers monitoring the large-scale test at the safety panel in the control room of the test stands

## Institute of Technical Physics

The Institute of Technical Physics develops laser systems for aerospace applications as well as in the areas of security and defence. At the DLR sites in Stuttgart and Lampoldshausen, scientists, engineers and technicians work on interdisciplinary issues in detection and removal of space debris, laser-based stand-off detection of chemical, biological or explosive (CBE) substances, laser effectors as well as optical sensor systems.



Laser-based stand-off detection: experimental studies give insights into the classification of harmful or explosive substances from a safe distance

At the Lampoldshausen site, priority developments focus on eye-safe laser systems as well as laserspectroscopic techniques. These are designed for sensitive applications such as fast, discreet and reliable recognition and identification of hazardous CBE materials. In case of an incident, laser-based technologies can detect those materials – helping to avoid risks to the population, first responders and the environment. In this context, laser beam propagation and its atmospheric effects (e.g. scattering at aerosols and rain) are investigated on DLR's free-space optical test range. Along with new laser sources, DLR researchers develop high-precision control systems for beam steering over long distances as well as highly sensitive detector systems.

## TTZ – TechnologyTransferCentre

The TechnologyTransferCentre (TTZ) represents the interface connecting the field of research and the manufacturing industry. The vast DLR know-how enables regional business enterprises to benefit from innovative and market-oriented aerospace technologies.

### Sun energy as a source of clean water

The technology transfer already yielded a first success with the solar waste water purification plant (SOWARLA). In 2008, the DLR project for solar water purification was awarded the “Energy Globe” in Brussels, a globally recognised prize for environmental achievements. Together with its affiliated companies, DLR received the prize for the development of a solar receiver enhancing the feasibility of solar-run water purification plants. SOWARLA cleans a portion of the waste water on site and pumps it through the tube-shaped receiver until the sun energy has eliminated the contaminants contained therein. Currently the construction of a second plant is planned for Kourou in French Guiana.



The solar-powered wastewater cleaning plant (SOWARLA) in Lam-poldshausen is used for demonstration and research purposes

## Technology transfer is an opportunity: **H<sub>2</sub>ORIZON**

The launcher rocket Ariane 5 made hydrogen the most important propellant in the European aerospace industry. Ever since Ariane's existence, DLR has ranked among the biggest users of hydrogen in Europe and is very experienced in dealing with large quantities of liquid hydrogen. In the future, hydrogen will be the essential energy source used by DLR. For this purpose, DLR and ZEAG Energie AG have established a presentation and research platform for the regenerative manufacturing and storage of hydrogen to be used in transport systems, test stands and heat and power supply.

The H<sub>2</sub>ORIZON project compiles research know-how from the aerospace and energy sector to respond to the need for environmentally friendly transport and CO<sub>2</sub>-neutral energy supply in today's society.

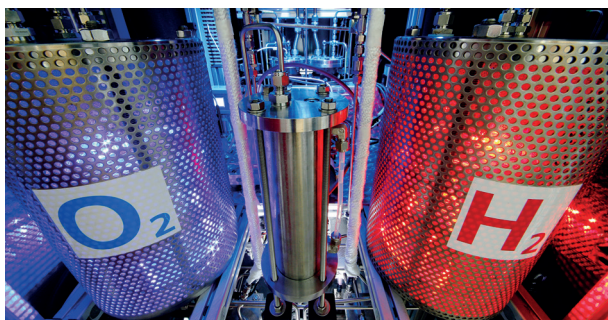


Image: DLR/Thomas Ernsting

Hydrogen electrolysis is defined as the splitting of water into hydrogen and oxygen using electricity

## Training and promotion of young talents

DLR is a state-recognised enterprise for the training of employees. This means that you cannot only do your practical internship while at school or undergoing vocational training, but we also have students writing their bachelor, master and PhD theses. We also train young people in skilled trades and technical professions to become industrial or electrical mechanics, for example. Additionally, we offer a further training scheme for technical staff, with DLR-related focus, to become test stand mechanics.

**Contact: [bewerbermanagement-la@dlr.de](mailto:bewerbermanagement-la@dlr.de)**

## **DLR\_School\_Lab Lampoldshausen/Stuttgart**

Middle and high-school pupils get the opportunity to unveil their experiment skills at DLR\_School\_Lab where they can participate in testing procedures that are closely related to practice and real life. This makes them acquainted with the working methods in natural science: observing, measuring, modelling, simulation and their interlinkage. It gives them a vivid impression of what physicists, chemists and engineers do as well as some insight into scientific work and research.

The experiments are conducted in line with the DLR research focus and provide a topically arranged cross-section of the science and technology applied in the aerospace and energy industry. All experiments are modular and scalable. The pupils assume responsibility for conducting and evaluating experiments in teamwork of small groups supported by a DLR scientist.

**Contact: [schoollab-la-st@dlr.de](mailto:schoollab-la-st@dlr.de) | phone +49 6298 28-0**



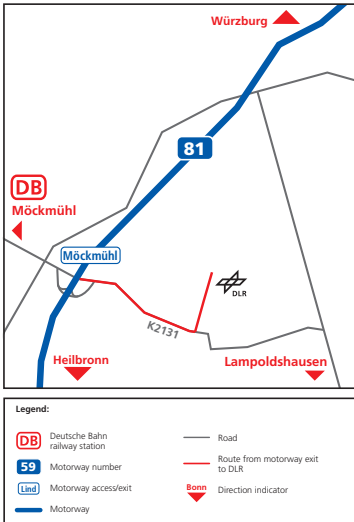
## DLR Lampoldshausen – directions

DLR Lampoldshausen is situated approximately 25 kilometres northeast of Heilbronn, in Hardthausen Forest in the Hardthausen community. You can reach us as described below:

**By rail:** from Heilbronn main station or Möckmühl station travelling from Heilbronn to Würzburg; take a taxi from there.

**By car:** motorway A81 Stuttgart to Würzburg, exit Möckmühl and follow the signposts to DLR (around 2 kilometres).

**By plane:** Stuttgart Airport, from there take the train (via Stuttgart main station) or go by car (approximately 1 hour) on motorway A8 – junction Leonberg – exit to A81. Frankfurt Airport, from there go by car (approximately 2 hours) on motorway A5 – junction Walldorf – exit to A6 – junction Weinsberg – exit to A81.



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## DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 20 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Bremerhaven, Dresden, Goettingen, Hamburg, Jena, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Oldenburg, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

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