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Upper Stage Test Facility P5.2

DLR Site Lampoldshausen

Brief description

The highly complex and extremely powerful P5.2 upper stage test stand was developed and built as part of the development of the future European Ariane 6 launcher under a direct contract from the European Space Agency ESA. It completes the DLR site's research and test portfolio.

Goals

- Future performance of upper stage refuelling and qualification tests as part of the planned European Ariane 6 launcher programme
- Shortening development times and increasing the maturity of chemical liquid space propulsion systems by combining research, development and engine testing at the site

Involved

European Space Agency ESA

Applications

- Unique capabilities for refuelling and qualification testing of cryogenic upper stages

Perspectives

- Flexibly adaptable to all liquid chemical space propulsion as well as entire upper stages

Facts and figures

Test duration: 17 h, of which up to 900 s with engine running
Test cell dimensions:
14 m x 14 m x 25 m
Cooling water required: 400 l/s
Thrust block load: up to 300 t
Vacuum level: approx. 100 mbar
Acquisition and processing of approx. 1,000 measurement signals

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

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Hot-fire tests are the ultimate challenge on the test facility. They place the highest demands on the technology and are therefore place particular requirements on the team and infrastructure. The DLR team is testing a cryogenic upper stage on a newly developed test stand for the first time in the long history of the Ariane programme in Europe. The findings from these tests are fundamental for finalising Ariane 6 and making it ready for launch. The team has prepared for the tests thoroughly. Maximum effort has been required to complete all the preparations on the seven-tonne upper stage, which has a diameter of 5.4 metres and a height of 11.6 metres. It was also necessary to develop and write complex software programmes in order to be able to precisely control and monitor all processes during the tests.

Up to three hot-fire tests are planned with the upper stage at DLR Lampoldshausen. These usually take around 17 hours each – after several weeks of intensive preparation. All aspects are simulated, including the preparation and post-processing of the stage. This includes fuelling with liquid oxygen and liquid hydrogen and emptying the tanks at the end of the test. The test stand team collects large quantities of important data during the tests. For example, about the ballistic phases in which the upper stage flies without thrust, referred to as coast phases, about the pressure build up in the tanks before engine ignition, about engine re-ignition and about the functioning of the nozzles that are used for attitude control.

The upper stage of Ariane 6 is equipped with a re-ignitable engine named Vinci®, tested on the High-Altitude Simulation Test Facility P4. It can be restarted up to four times and can fire from a few seconds to more than 14 minutes. This makes Ariane 6 very flexible, able to address a wide range of missions and to head for several target orbits, each with a different mission profile.

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