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DLR tests new nozzle for Ariane 5 main engine

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Representatives of the space industry and participating space agencies travelled to Lampoldshausen for the testing

With the last two tests completed, the current test campaign for Ariane 5's Vulcain 2 main engine at the facilities of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) in Lampoldshausen reached its culmination at the turn of last year. The team tested a new nozzle design (codenamed NE-X) for the first time.

The nozzle was developed and built by the Swedish company Volvo Aero, under contract from the Swedish Space agency. The new design features an innovative sandwich construction: an external metal cone is laser-welded to an inner one, doing away with the numerous cooling ducts of the current design. The result is a construction that is considerably cheaper to produce than the existing Vulcain nozzles, as well as lighter and more powerful, thus increasing the payload capacity and cost-efficiency of the Ariane 5.

Technical feasibility tests

The engine nozzle NE-X on the P5 test stand at the DLR facilities in Lampoldshausen

The tests were an important step towards the verification of the numerical simulations for the NE-X nozzle. Six cameras were used to take pictures of the nozzle during ignition in the visual and infrared ranges, so that the functionality of the nozzle can be assessed after a preliminary analysis. "The means to test these components on the test stand is a crucial step in a long verification procedure. Testing under real conditions is one of the most important milestones in developing complex engine components and is a decisive factor in ensuring that the system functions as it should in actual deployment," says Anja Frank, Head of Test Facilities at Lampoldshausen.

New technology on a proven test stand

P5 test stand

Since commissioning in 1990, the P5 test stand has provided more than 100,000 seconds of run time for numerous tests as part of the development and qualification process of the Vulcain engine. Fundamental modifications to the P5 have made it possible to adapt it to ever-changing test requirements. For example, the most recent tests of the NE-X nozzle were an enormous challenge for the exhaust guidance systems of the test stand, which have to conduct the enormous energy of the engine’s exhaust away from the test facility. The separate turbine exhaust ducts, which run along the nozzle, create an asymmetrical stream of exhaust gas that considerably increases the thermal stress on the test stand’s guidance systems. The solution is to increase the flow of coolant water to the affected areas.

Another modification was the replacement of the 20-year-old computer with an updated system, which was commissioned as part of the test series. During the eight test runs, the computer controlled and monitored the switching of the valves as well as temperatures and pressures on the engine and on the test stand itself in real time, contributing to the safety and smooth running of the tests.

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