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DEMONSTRATION OF A FULL SCALE LASER WELDED CHANNEL WALL NOZZLE IN HOT TEST ON THE VULCAIN 2 ENGINE

Abstract

Volvo Aero has for over ten years continuously developed and improved its patented manufacturing method for actively cooled nozzle extensions, i.e. the laser welded channel wall technology (referenser?). The full scale Vulcain 2+ Nozzle Extension Demonstrator is now ready for hot testing. The Volvo Aero ambition is to mature the technology to TRL 6 in order be ready for the next planned upgrade of the European Space Agency's ARIANE 5 commercial launch vehicle. The project is closely followed and reviewed by CNES, and performed in cooperation with Volvo Aero's industrial partners EADS Astrium and Snecma, the full scale hot tests are performed at the DLR test facility in Lampholdshausen, Germany.

The nozzle manufacturing is finalized and the NE is extensively instrumented in order to study the improved performance in the full scale hot tests. The hot fire testing gives invaluable data on the functional parameters and the structural integrity of the Vulcain 2+ Nozzle Extension Demonstrator. The Vulcain 2+ NE Demonstrator, a full length dump cooled laser welded sandwich wall nozzle extension, is made from two sub assemblies joined together. Parts of the stiffening structure on the upper assembly are manufactured with laser metal deposition. Thermal Barrier Coating is applied partly on the flame side to show possible reduction of heat exposure in critical areas where high temperature has been predicted, the instrumentation of the NE allows for comparison of dump cooling performance with and without TBC. In total the NE is equipped with 157 gauges in order to record the test data. For the performance of the coolant system, the NE is fitted with thermal gauges on the hot wall, thermal and pressure gauges inside the coolant and also on the external side of the NE. Side loads and shock characteristics during start-up and shut-down transients are recorded by 60 dynamic pressure transducers as well as 10 accelerometers to monitor the NE response. General test objectives with the NE are:

- To verify the function of the mechanical structure of a sandwich wall with reinforcements for the actual heat load
- To show robustness with respect to operating point
- To verify the mechanical properties of the nozzle
- To verify the temperature level for design tool validation
- To evaluate the main jet separation and side load characteristics