

News-Archiv Stuttgart

SHEFEX – hot re-entry with sharp edges

26 September 2005

SHEFEX flight experiment on the launch pad



Cologne/Andoya - By launching its SHEFEX (Sharp Edge Flight Experiment) project, the German Aerospace Center (DLR) has set itself the objective of testing new thermal protection concepts for spacecraft returning to Earth and at the same time of testing the suitability of a sharp-edged design for the aerodynamic configuration.

The unique flight experiment is a DLR research project involving industrial partners. Plans are in place to launch from the launch site on the Norwegian island of Andoya on 27 October 2005.

The carrier used is a combination of a Brazilian VS-30 as the bottom stage and a HAWK rocket as the top stage. These parts are usually only used for altitude research. After its launch over the Norwegian Sea, SHEFEX will reach an altitude of 300 kilometres and re-enter the Earth's atmosphere at almost seven times the speed of sound: a speed which is fast enough to produce temperatures of up to 1600 degrees Celsius at the tip of the SHEFEX payload.

During re-entry, the experimental unit remains linked to the HAWK rocket in order to use its rudder surfaces to stabilise the attitude of flight. Once the parachute system has been activated, SHEFEX will touch down at sea approximately 300 kilometres from its launch site and will be salvaged for further analysis. The most important measurement data is transferred to the ground station during the flight.



Aerial view of the launching area

The project uses a ceramic re-usable thermal protection system technology, highly advanced in Europe. Fibre-reinforced ceramics, displaying a low weight and resistance to extreme temperatures, are the materials used to produce such systems.

The high costs involved in the production and quality checking of components with complex shapes should be cut dramatically by the structure of the plate-shaped panels and the reduced range of types used here. On re-usable carrier system concepts such as the US Space Shuttle, this structure would result in considerable savings on maintenance and the replacement of damaged elements. The concept could however lead to aerodynamic problems and local overheating at the structure's edge transitions. Given the most recent findings from the field of thermal structural behaviour and new types of active cooling techniques, it should be possible for these effects to be overcome.



Preparing a similar rocket in Brazil

SHEFEX is being used to investigate the fundamental aspects of the feasibility of such 'faceted' external shapes and their flight capability. The missile has all the characteristic shapes, such as convex kinks and convex shapings, required by any meaningful aerodynamic and structural investigation. Alongside the ceramic thermal protection system, SHEFEX therefore also includes a multitude of sensors which allow for extremely accurate recording of the thermal and aerodynamic effects during the flight.

The aerodynamic design, the theoretical prediction of flow characteristics and tests in the plasma wind tunnel were undertaken at the DLR Institute of Aerodynamics and Flow Technology in Brunswick, Cologne and Göttingen. The SHEFEX experiment was developed, produced and integrated at DLR's Institute of Structures and Design in Stuttgart. DLR's mobile rocket base (Moraba) in Oberpfaffenhofen is being used to prepare the rockets and to carry out the launch.

EADS and MT-Aerospace are involved in other experiments on new types of thermal protection systems involved in the SHEFEX flight experiment.

The three-year project has been financed by the Helmholtz Association of German Research Centres (HGF) and DLR as part of their space programme.

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