

FLIGHT EXPERIMENTS DEVELOPMENT

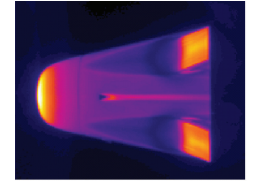


EXPERT PROGRAM

The European Space Agency started the EXPERT (European eXPERimental Reentry Testbed) program in 2000. The aim of the EXPERT program is to provide an opportunity to the European scientific community to propose and perform in-flight experiments in order to obtain aerothermodynamic data for the validation of numerical models and of ground-to-flight extrapolation methodologies. In the framework of this program VKI developed two instrumented payloads (Payload 5 and Payload 11) to address specific critical aero-thermal in a flight environment.

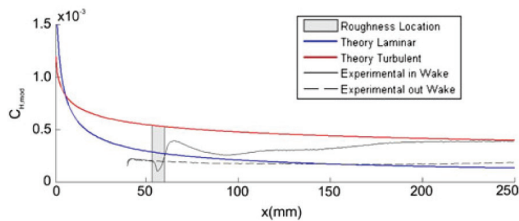


EXPERT Re-entry Vehicle



Wind Tunnel Model Testing

Payload 5 is dedicated to validate the methodology for predicting the roughness induced boundary layer transition. The effect of the surface roughness is a key parameter in the design of a flight vehicle. The process of boundary layer transition is accompanied by high surface thermal loads and high skin friction that could impact dramatically the stability of the vehicle, its aerodynamic coefficients and the thermal protection system.



Stanton number along the roughness wake

Payload 11 is instead dedicated to assess the catalytic properties of two different materials at the junction between the nose and the body of the vehicle. A correct validation of the methodology used to predict a specific material catalycity in flight will provide a tool to better design the thermal protections of the future.

Both payloads have been designed and developed at VKI along the phase B/C and D of EXPERT program. They have been successfully flight qualified and integrated on the Vehicle which is now ready to be launched.

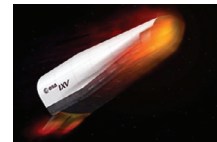
INTERMEDIATE EXPERIMENTAL VEHICLE (IXV)

Since 2005 ESA developed the Intermediate eXperimental Vehicle (IXV). Such program aims to consolidate Europe's autonomous position in the strategic field of atmospheric re-entry for applications ranging from future ambitious space transportation to exploration. A numbers of key technologies for re-entry maneuvers are integrated in the vehicle's project.

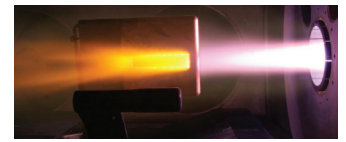
VKI was actively involved for the establishment of the aerothermodynamic database (ATDB) and more specifically for the design of the Thermal Protection System (TPS).

VKI is also responsible for the development of an in-flight experiment to assess the Gas-Surface Interaction (GSI) phenomena along a lifting type re-entry trajectory. The flight experiment is called CATE, for Catalysis Experiment. It consists of two catalytic patches, instrumented with thermocouples, at different locations on the windward side of the vehicle. Such coating will promote a catalytic jump due to the wall chemistry discontinuity that will allow to investigate the reaction-diffusion processes associated with the GSI phenomena during a re-entry flight.

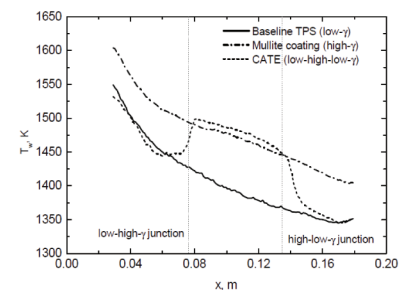
CATE has been inspired from space shuttle experiments; its adaptation for IXV has been completely developed at VKI. Particular attention was devoted to the duplication of the flight conditions in ground testing facility taking into account all the specific features of the re-entry flight.



IXV re-entry



Ground testing for CATE



Catalytic jump experiment



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