

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures 1 - Development and Verification (Space Vehicles and Components) (1)

Author: Mr. Thomas Thiele
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany

Mr. Ali Gülhan
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany

Dr. Jürgen Häberle
Astrium Space Transportation, Germany

Mr. Carlos Pereira
beyondgravity, Switzerland

Dr. Marco Di Clemente
CIRA Italian Aerospace Research Centre, Italy

Prof. Thomas Roesgen
ETHZ, Switzerland

Mr. Thoemel Jan
The Netherlands

INSTRUMENTATION OF THE EXPERT FLAP FOR WIND TUNNEL TESTING AND EVALUATION
OF TEST RESULTS

Abstract

In the frame of the ESA EXPERT project the re-entry vehicle is used as a flight testbed to obtain aerothermodynamic flight data for the validation of design tools, ground test facilities and verification techniques with the further aim of improving reliability and reducing uncertainties for future re-entry missions. One of the scientific experiments (payload 6) of EXPERT is the “Measurement of Control Surfaces Aerodynamic Efficiency and Heating” which was developed by the Supersonic and Hypersonic Technology Department of the DLR. The payload consists of the instrumentation of two control surfaces (flaps) and their corresponding cavities with temperature, pressure and heat flux sensors. Another EXPERT payload designed by RUAG (payload 8) measures the rear side temperature of one flap using an infrared camera to calculate the front side heat flux distribution using an inverse method. Thereby the payload 6 temperature sensors are also used as reference for the infrared measurement. To assess the design of the flap and its corresponding instrumentation (payload 6 and 8) under flight representative conditions wind tunnel tests were performed at the CIRA SCIROCCO plasma wind tunnel. For these tests the flap was instrumented in flight configuration, consisting of 10 thermocouples attached to the rear side of the flap and 5 pressure ports measuring the flap surface pressure distribution. The rear side temperature of the flap was also measured by the infrared camera of RUAG. Furthermore two infrared cameras and two pyrometers from CIRA were used to measure temperatures at the front side of the flap. This paper presents the overall layout and design of the SCIROCCO EXPERT flap instrumentation together with the evaluated temperature and pressure distributions from the wind tunnel campaign. Comparisons are done between the different measurement systems, e.g. comparison of thermocouple with infrared data. In addition some numerical results from CFD simulations are presented and compared with the experimental data.