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Author: Dr. Francesco Di Caprio
CIRA Italian Aerospace Research Center, Capua, Italy, f.dicaprio@cira.it

Mr. Domenico Cristillo
CIRA Italian Aerospace Research Center, Capua, Italy, d.cristillo@cira.it
Dr. Giuseppe Petrone
Università degli Studi di Napoli "Federico II", Italy, giuseppe.petrone@unina.it
Mr. Antonio Zallo
AVIO S.p.A., Italy, antonio.zallo@avio.com

STATIC AND DYNAMIC CHARACTERIZATION OF A METALLIC COMPONENT OF VEGA-C INTERSTAGE 2/3

Abstract

The aim of this paper is to provide the weight saving optimization procedure developed for the design of the supports equipment mounted into the VEGA-C launcher Interstage 2-3. The optimization process is set up to obtain a weight saving of the component and, at the same time, to satisfy the environmental requirements prescribed by the Vega General Specifications. In particular the component must have:

- a frequency greater than 100 Hz in longitudinal direction and 50 Hz in lateral direction;
- an amplification factor less than 15;
- the capability to withstand four different static loads.

In order to satisfy all these requirements as well as saving weight, a routine able to combine the specific advantages of two different commercial codes ANSYS and NASTRAN, has been developed. After the numerical optimization, a validation of the model by means of an experimental test campaign has been performed. These tests aimed to evaluate the dynamic behavior of the component in terms of natural frequencies and mode shapes. Firstly, an hammer test campaign in free-free boundary conditions has been performed. The structure has been excited by an impulsive load and five mono-axial accelerometers has been used to measure the response over the surface. The acquisition system LMS SCADAS III, with the bandwidth 0 – 1000 Hz and a frequency resolution 1 Hz, has been used to record the frequency responses. Data has been post-processed by means of PolyMAX function implemented in LMS Test.Lab commercial software. Results underline a good correlation both in terms of natural frequencies and mode shapes (values are in good accordance with values always higher of 60Once the FEM has been validated, real configuration (by reproducing the conditions of fastening on the interstage structure) tests has been performed. In order to accomplish the task, a specific test rig, able to replicate the interstage structure, has been designed and manufactured. The dynamic test has been performed by using a shaker to simulate the vibration source and the response has been measured by means of two tri-axial accelerometers. Finally, three experimental compression static tests were performed placing the test rig and the test article in three different positions in the testing facility, in order to apply the load in three different directions (longitudinal, radial and tangential). The obtained experimental results (static, dynamic and modal), used to validate the developed design numerical procedure, allowed to define the accuracy and reliability level of the developed numerical model. Further studies will be performed by testing the other support equipment.