

Advanced Composite Materials and Technologies for Large Solid Rocket Motors

V. Vinti, R. Buono, P. Perugini, A. Mataloni, F. Lillo,
Avio S.p.A.

B. D'Andrea
Avio S.p.A. Senior Consultant

Abstract

The solid propulsion is confirmed since several decades as one of the more reliable, effectiveness and cost-sustainable technologies for the space launchers. The architecture of Ariane 5 includes strap-on solid boosters for takeoff, similarly to most of the heavy worldwide launchers currently in service and the future Ariane evolution will keep the solid technology as base configuration as well.

Therefore, the improvement of the solid rocket motor in the perspective to increase performance, reduce costs and enhance reliability is within the priority themes for the future developments.

The introduction of the structural composite materials for the motor cases replacing the steel, is one of the main steps ahead performed in the past years. The new launcher Vega is conceived with three SRMs with composite cases, having great advantages in the reduction of inert mass. The extensive use of composite cases and the fact that the carbon-fibers epoxy prepreg for space motors are quite strategic materials, require to include the composite materials in the research and development activities, as additional area, in order to carry on the improvement on this core technology.

In particular, since several years Avio has been developing in-house carbon-epoxy prepreg, through extensive research on pure epoxy resin and impregnation process by the pilot plant of prepreg tow and tape.

The in-house prepreg named HEX-23 has specific characteristics tailored for the filament winding technology on large motor case and a rheology to optimize the mass curing, on the lessons learned of the Vega qualification.

Several tests have been carried out and will be presented in this paper, together with the highlights of the prepreg, the fibers selection for the first and upper stages application.

This prepreg will be tested at full size level through the Zefiro40 SRM, the new second stage rocket motor under development in Avio, with extremely high modulus fibers

Fig. 1 P80 SRM filament winding phase



Fig. 2 Standard Small Vessel specimen with HXE-23 prepreg and raw materials carbon-epoxy prepreg TOW and TAPE



Fig. 3 Impregnation line of carbon-epoxy prepreg TAPE HEX-23 in Avio

