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QUALIFICATION PROCESS FOR ADDITIVE MANUFACTURED METALLIC CONNECTING FLANGES FOR SPACE LAUNCHER

Abstract

In direct response to the rising demand of satellites and spacecraft launches into space, both governments and private companies have shown interest in increasing launcher capabilities and reducing costs in order to increase their competitiveness. The most attractive architecture is the multistage one which allows to increment the global performance thanks to reduction of mass during the ascent phase. Such an architecture requires that different main parts, i.e. the stages, are stacked one on top of the other and that these are disconnected when they are no longer functional to the mission. All stages are produced separately and then they are assembled at the launch site by means of interfacing flanges that, historically, consist of massive aluminum ring flanges, bolted on the main part and each other. The proposed design of connecting flanges is based on two different components replicated all around the circumferential perimeter. They allow to reduce both the time and the costs related to the manufacturing and assembling, and, at the same time, to increment the structural performance by means of a relevant weight saving, which, in turn, lead to an increment in the launcher capability. The structural configuration has been defined in order to fulfill the design requirements of the Interstage 2/3 of the Vega C launcher, that is a monolithic aniso-grid composite structure, that represents a very good case study thanks to its particular topology. In order to meet the challenging requirements and to obtain the most efficient design possible, the traditional manufacturing constraints have been removed and the additive layer manufacturing technology (ALM), with the related design approach, was adopted. ALM is a digital technology of layered fabrication by adding material, where no cutting tool is required as in the case of a subtractive manufacturing process. The advantages of the use of ALM for aerospace parts are numerous: the reduced lead time and associated cost, the ability to design and manufacture complex geometries that enable light weighting, consolidation of multiple components and improvements in performance. The innovative flange system has been designed and manufactured in Ti6Al4V, that is the best candidate for integrating in composite structure due to their reciprocal compatibility, by means of Electron Beam Melting (EBM) technology. All activities devoted to define a qualification procedure for ALM process and related products, according to the ESA ECSS standards, are described in detail.