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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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DEVELOPMENT OF DIMENSIONALLY STABLE STRUCTURE OF DRAWTUBE OF OPTICAL DEVICE OF COMPOSITE MATERIAL

Abstract

Development of dimensionally stable structures for the space application which meet the requirements of the modern developmental level of aerospace technology is almost impossible without composite materials. Nowadays, Yuzhnoye SDO is working on the dimensionally stable structures design, manufacturing and testing. One such example is development of dimensionally stable structure of drawtube of the CFRP optical device. This drawtube is a supporting structural element for optical mirrors. The primary objective of the drawtube is to maintain the dimensional stability during spacecraft operating cycle to keep the pre-defined position of optical mirrors and ensure the quality of optical-electronic equipment. When using composite fiber materials in dimensionally stable structures, the most important objective is to select the qualitative and quantitative composition and layup schedules to define the required coefficient of thermal expansion with the defined value of strength properties of the designed structure. The main feature of this work is application of analytical method of designing dimensionally stable structure. This method is the basis for the design engineering procedure for shell cylindrical structures made of composite materials. Applicability of the procedure was confirmed by calculations of the strength of structure by finite element method and dimension-stability tests of cylindrical test samples (with different layup schedules), as well as dimension-stability tests of the structure of the drawtube. Such procedure allows to optimize the physical-mechanical properties of composite structure and shows the ways to reduce weight and overall dimensions of the structure. The drawtube rational design is examined in this paper. Presented analytical design method allows to calculate approximately the required physical-mechanical characteristics of the structure at the design stage. Analysis of the influence of processing technique is examined. The analysis permits to expand the allowable angle of fiber orientation without great impact on the thermal-dimensional stability and strength properties of the structure and to simplify the technological requirements. The features of performing dimension-stability test for measuring the coefficient of thermal expansion and the tests results analysis are presented. The paper also provides a comparison of the desired, calculated and measured physical-mechanical characteristics of the structure.