

## DETERMINATION OF OPTIMAL SPACECRAFT RELIABILITY NORMS WITH ACCOUNT FOR ECONOMIC INDEXES

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The goal of this paper is to develop a method for determining the values of system failure rates optimal in terms of net profit maximization with account for spacecraft mass limitations. It is adopted that the spacecraft systems are independent in terms of reliability, each of them can be only in two states (a functioning state or a failure state), and each equipment type of the special complex makes an independent contribution to the overall effect. The paper considers the case where the spacecraft system failure time obeys the exponential law. Use is made of the Lagrange multiplier method and numerical optimization methods. The problem is solved using the mass – failure rate and cost – failure rate relationships of the spacecraft systems. For the supporting complex, the dimension of the mathematical simulation problem is reduced to two: a formula is derived to find the optimal failure rates of all the systems of the supporting complex using the optimal failure rates of two systems of it. The variables for the special complex and the supporting complex are separated. Due to the fact that each special complex system makes an independent contribution to the overall effect, the problem for the whole spacecraft is reduced to a system of two equations for the special complex and the supporting complex and  $n_{cn}$  equations in one variable for the special complex with two coupling variables between the supporting complex and the special complex where  $n_{cn}$  is the number of the special complex systems. The paper presents a numerical-and-analytical method for spacecraft system failure rate optimization where the initial guess is specified indirectly: by specifying the supporting complex mass and probability of no-failure operation. The method may be used in the development of a space hardware design methodology accounting for economic factors. From the optimal values of the spacecraft system failure rates found using the mass – failure rate and cost – failure rate relationships, one can find the masses and costs of the spacecraft systems to be used in optimizing the parameters and development cost of the systems. The method is expected to increase the profitability and competitiveness of spacecraft under development.

**Keywords:** *optimal reliability norms, spacecraft, profit, cost, design.*

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