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BASIC PARAMETERS' OPTIMIZATION CONCEPT FOR COMPOSITE NOSE FAIRINGS OF LAUNCHERS

Abstract

New optimization concept for basic parameters of structure diagrams of composite nose fairings of launchers (LNF) is considered. The concept is based on the integrated computerization of designed object lifecycle and includes solving the tasks of designing, technology, operation, ecology and safety of production activity.

In the structure diagram of sandwich composite LNF with honeycomb filler (HF), multistage algorithm of minimization of its key structural elements' weight at simultaneous thermal and force effects is used.

This algorithm allows deep-level optimization of thermal-protective coating (TPC) thickness, base layers' reinforcement pattern, HF height, geometrical parameters of its cell, and LNF shell rings.

The first block of the algorithm carries out preliminary analysis, gives recommendations for subsequent optimization of TPC parameters, and determines the values of physical-mechanical characteristics with optimal ranges of TPC thickness variation for various nose fairing sections.

The second block is meant for choosing the rational correlation of TPC thickness, external and internal base layer thicknesses (with the optimal reinforcement pattern), HF height and size of the regular hexagon-shaped cell.

Additional reduction of NF weight is possible using the third weight optimization block where rational parameters of honeycomb cells of irregular hexagon shape are chosen. Fixed values of obtained optimal parameters of the second block are entered in the third block, where by varying the angle of honeycomb cell opening and coefficient of its shape in each nose fairing module the HF structure is optimized.

The optimal parameters of HF cell are entered in verification blocks where the required calculations of the optimal variant of LNF structure are made. The first three blocks of the algorithm solve the task of optimizing parameters of base layers and HF in the regular zone of nose fairing structure, and further blocks – in local zones.

Therefore, the given approach to minimization of weight of irregular zones of the composite NF determines:

- rational shape of the reinforcement plate of varying thickness, which geometrical parameters correspond to occurring flow of forces;

- base layer thickness for various reinforcement plate zones; - rational values of reinforcement parameters for honeycombs.

The offered concept was implemented at weight optimization of structural parameters of Cyclone- 4 LNF which allowed reducing its weight considerably compared with initial variant.