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Experimental system for studying the effect of the arrangement of nonhermetic module fillers on the outgassing flow density

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In recent years, components and materials of industrial and commercial quality have been in frequent use in the assembly of small spacecraft to reduce the cost of space projects. This may affect spacecraft and onboard equipment reliability and performance quality. In particular, a high risk may arise from unpredictable performance characteristics of components and materials of this type caused by outgassing flows of unregulated density. The situation is aggravated by difficulties in numerical simulation of the complex internal geometry of actual nonhermetic small spacecraft. The most efficient way to resolve this problem is to conduct laboratory tests.

This paper presents an experimental system for studying the dependence of degassing processes on the geometry of arrangement of electronics boards and various structural materials in a nonhermetic module. The theoretic basis for experiments is a differential realization of the accumulation method, which allows one to differentiate the density of degassing flows from particularly arranged specimens and elements of the module's inner surface.

To reproduce the design features of nonhermetic nano- and picosatellites, models of nonhermetic modules were refined, and a special laboratory module was made on their basis. For this purpose, a unit of synchronous module evacuation control was updated, equipment was developed for positioning plate-type fillers of nonhermetic modules, the recording of gas-dynamic parameters of a nonhermetic module's own internal atmosphere was provided, and an automated experiment control system was prepared. The laboratory module was integrated into the automated measuring system of the VAU-2M vacuum aerodynamic installation of the Institute of Technical Mechanics of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine. The experimental system developed was tested to show a satisfactory operability of both its components and the system as a whole.

The system developed allows one to study outgassing from the surface of various components and materials, to measure the density of outgassing flows for various equipment arrangements, and to study the dynamics of outflow of the products of the own internal atmosphere through calibrated orifices, which simulate the outflow of the own internal atmosphere of a nonhermetic module through its unregulated clearances.

Keywords: *small spacecraft, nonhermetic module models, fillers, electronics plates, arrangement, flat channels, outgassing, own internal atmosphere, outgassing flow density.*

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