SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

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DETERMINATION OF COORDINATES FOR A POINT OF PRESSURIZED COMPARTMENT PUNCTURE AT COLLISION WITH A HIGH-SPEED PARTICLE

Abstract

Nowadays a number of space debris is constantly increasing due to extended space activities and man-caused particles generated in consequence of destruction of space objects at explosions and collisions. This brings to increased probability of a space vehicle (SV) collision with space debris. Tracking of the most dangerous particles with dimensions less 10 cm is impossible in practice. An experience accumulated during operation of manned space vehicles indicates on necessity to increase SV survivability, in case of emergency depressurization. The prime objective at depressurization is immediate determination of a place of puncture since visual determination is impossible for large space systems like ISS. Solution of this problem permits to take urgent actions on remedying the pressurized compartment depressurization. Shock wave in the compartment atmosphere appeared at puncture of its shell by high-speed particle is one of stable factors accompanying this process that allows using it in control systems for recording a fact of impact and determining the coordinates of puncture point and the time moment of depressurization. The system for determining the puncture coordinates operates basing on diversity of times when front of acoustic disturbances is detected by transducers located inside the pressurized compartment. Requirements on an apparatus for measuring the parameters of acoustic wave are defined by requirements on reliable registration of useful signal at noise background inside SV pressurized compartment. Acoustic waves appeared at puncture of the compartment shell by a high-speed particle were studied using TSNIIMASH experimental facilities, the wall puncture was realized with the help of gas-cumulative unit, and also ISS mock-ups were used. These studies showed that it is possible to record the fronts of acoustic waves appeared at the compartment depressurization with the help of compact transducers under the condition of their sufficiently high amplitude and time resolution and to find the puncture location. Using software devised for the recording device it is possible to find expediently, in the time interval less 1 s after collision, the coordinates of puncture location. Error of determining the puncture coordinates is less 0.1-0.15 m for empty compartment and not higher 0.5m for a compartment with process environment.