

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

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FRAGMENT CHARACTERISTIC OF SIMULATED SPACECRAFT UNDER HYPERVELOCITY  
IMPACT

**Abstract**

Hypervelocity impact tests on simulated spacecraft were carried out to investigate the fragment debris characteristic, such as debris size distribution and mass distribution, to support the breakup modeling of spacecraft. There were two configurations of the simulated spacecraft: simple and complex. Both the two configurations were aluminum alloy boxes, in the shape of hexahedron but with different inside structures. In the simple configuration, some aluminum clapboards were installed to separate the inside space to several grids. While in the complex configuration, there was a central tube with some aluminum clapboards attached with some simulated electronic boxes.

Totally three shots were fired. The first two used simple configurations as targets which were 100mm\*100mm\*100mm and 200mm\*200mm\*200mm, impacted by aluminum projectiles that were 4.8 grams and 38.9 grams in mass, at the velocity of about 4km/s. The third used complex box which was 400 mm\*400mm\*400mm, impacted by an aluminum projectile that was 97.6 grams in mass, at the velocity of about 3km/s. The targets were fragmented in all the three shots. 'Soft Catch' devices were used to collect the fragment debris, and over 96% of the target masses were collected. Each of the debris was weighed, measured and cataloged. Some analyze was performed according to the method used in NASA Standard Breakup Model.

The debris distributions showed the similar laws in all the three shots. The cumulative number (equal or greater than a given length or given mass) yielded as linear relationship with debris character length or character mass. The line could be divided to three zones which were corresponding to three generation mechanisms of debris. An expression formula was obtained by data fitting. It could be found that there was some distinction between our formula and NASA EVOLVE model. The estimated lines from NASA model were higher than lines from collected debris, and the estimated line's slope was greater than test line's. It meant that the NASA model over estimated the debris number under the condition of our three shots, what should be further studied.

Key words: Simulated spacecraft; Hypervelocity impact; Fragment; Debris characteristic