



[Purchase PDF](#)


[Access through another institution](#)



Advances in Space Research

Volume 43, Issue 7, 1 April 2009, Pages 1058-1064



Recommended articles

No articles found.

A study of the material density distribution of space debris

John N. Opiela  

Show more 

 Add to Mendeley  Share  Cite


<https://doi.org/10.1016/j.asr.2008.12.013>


[Get rights and content](#)

Abstract

Material density is an important, yet often overlooked, property of orbital debris particles. Many models simply use a typical density to represent all breakup fragments. While adequate for modeling average characteristics in some applications, a single value material density may not be sufficient for reliable impact damage assessments. In an attempt to improve the next-generation NASA Orbital Debris Engineering Model, a study on the material density distribution of the breakup fragments has been conducted and summarized in this paper.

The material density distribution of the on-orbit breakup debris population may be estimated by combining three sources of data: available pre-launch information on satellite materials, ground-based satellite breakup experiments, and chemical compositions of residuals collected from returned surfaces. Analysis of these data provides a basis to compile a simple mass density distribution. For example, about 75% of on-orbit breakup debris fragments come from upper stages, which are simpler and more standardized than payloads in construction and composition. Available material information from manufacturers can be used to develop a reasonable distribution function for this component. For spacecraft breakup debris, it has been found that the range of material densities may be simplified into three representative values: high (e.g. steel), medium (e.g. aluminum), and low (e.g. plastic). The current study develops preliminary distributions for breakup debris: rocket body debris is 90% medium-density and 10% high-density (by number); payload debris is 70% low-density, 27% medium, and 3% high-density. Although the three data sources mentioned above are not comprehensive, and some interpretation and extrapolation are needed, the resulting density distributions still represent a step forward in providing more reliable damage assessments for future debris models. Future work will refine the data and provide distributions as functions of particle size and orbital altitude.

 Previous article

Next article 

Keywords

Orbital debris; Debris; Composition; Materials; Breakup; Modeling

Cited by (0)

[View full text](#)

Copyright © 2008 COSPAR. Published by Elsevier Ltd. All rights reserved.