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SPACE DEBRIS SYMPOSIUM (A6)
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HYPERVELOCITY IMPACT TESTING OF DEBRISAT TO IMPROVE SATELLITE BREAKUP MODELING

Abstract

An effort by NASA and DoD is underway to update the standard break up model in the form of a hypervelocity impact test on DebriSat. DebriSat is a 50 kg class satellite designed to comprehensively represent modern LEO satellites. Instrument and material selections were based on a study of 50 satellite missions with data available in the public domain. The chosen missions formed a representative distribution by dry mass of satellite missions, creating a manageable group from which to collect data on the prevalence of instruments and materials used in satellites ranging from 1 kg to 5000 kg.

Analyzing the distribution of technologies utilized for different subsystems, the team included instruments that were common in most mass categories. For example, in the attitude determination and control subsystem, sun sensors and magnetometers were common across most satellites while gyroscopes and inertial measurement units were more prevalent with increasing satellite mass. Star trackers were also widely used technologies in the mid-range satellites. These instruments are represented in DebriSat based on these findings. A similar instrument identification approach was used for the payload, propulsion, command and data handling, and other subsystems within DebriSat. Common materials found in modern satellites and utilized in the fabrication of DebriSat include aluminum 6061-T6, stainless steel 316, titanium, aluminum 5052 honeycomb, M55J composite, and multi-layer insulation.

The DebriSat design is intended to be representative of the materials, instruments, and assembly processes involved in modern satellite construction. Throughout the design and assembly phases, subject matter experts from NASA, DoD, and The Aerospace Corporation were consulted for guidance and recommendations. As with any flight hardware, strict guidelines were followed to ensure that the final

product met all the qualifications of a flight ready satellite (sans software). DebriSat was also subjected to appropriate environmental testing including vibration, thermal, and bakeout, to ensure flight readiness. This paper describes the DebriSat design, fabrication, and test results obtained to date.