

Observations of Micrometeoroid and Orbital Debris Impact Damage to the International Space Station

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ABSTRACT

Paper will describe micrometeoroid and orbital debris (MMOD) damage that has been observed on the International Space Station (ISS). Several hundred documented MMOD damage sites on ISS have been identified using imagery taken from ISS windows. MMOD damage sites visible from ISS windows are typically larger – on the order of 5mm diameter and greater – due to the larger viewer-to-surface distance. Closer inspection of these surfaces by astronauts during spacewalks reveals many smaller features that are typically less distinct. Characterization of these features as MMOD or non-MMOD is difficult, but can be partially accomplished by matching physical characteristics of the damage against typical MMOD impact damage observed on ground-based impact tests.

Numerous pieces of space-exposed ISS hardware were returned during space shuttle missions. Subsequent ground inspection of this hardware has also contributed to the database of ISS MMOD impact damage. A handful of orbital replacement units (ORUs) from the ISS active thermal control and electrical power subsystems were swapped out and returned during the Space Shuttle program. In addition, a reusable logistics module was deployed on ISS for a total 59.4 days on 11 shuttle missions between 2001 and 2011 and then brought back in the shuttle payload bay. All of this returned hardware was subjected to detailed post-flight inspections for MMOD damage, and a database with nearly 1000 impact records has been collected.

A description of the largest observed damage features will be provided in the paper. In addition, a discussion of significant MMOD impact sites with operational or design aspects will be presented. Some of the ISS modules/subsystems damaged by MMOD to be included in the discussion are (1) Solar Arrays, (2) US and Russian windows, (3) Extravehicular Activity (EVA) handrails, (4) Radiators, and (5) Russian Functional Cargo Block (FGB) module.