It's getting crowded out there!

Engineers for Boeing, NASA test effects of orbital debris on ISS

By Ed Memi

Space is getting more cluttered with man-made objects that no longer serve a useful purpose. Numbering in the tens of millions, these objects—called orbital debris—can include things like spent rocket stages, defunct satellites, dust and even paint flakes.

Approximately 11,000 orbital debris objects larger than 10 centimeters (4 inches) are regularly tracked. There are an estimated 100,000 particles between about 1 and 10 cm, and the number of particles smaller than 1 cm probably exceeds tens of millions.

Space debris has become a growing concern in recent years, since collisions at orbital velocities can severely damage functioning spacecraft. Orbital debris is a problem to the International Space Station (ISS) because collisions can occur at speeds of, on average, 6.2 to 6.8 miles (10 to 11 kilometers) per second.

Although the station will have, upon completion, some 20,000 pounds (9,100 kilograms) of debris shields—and although NASA mission controllers periodically maneuver the space station to avoid large debris—it's the smaller pieces that pose the biggest threat to the station. The ISS is routinely struck by cosmic dust and orbital debris smaller than half an inch (1.3 cm); and its components can be damaged by tiny particles as small as a paint chip.

A team of Boeing and NASA engineers is studying the effect of small orbital debris upon impact with the space station to help determine the spare parts that might be needed to replace damaged station parts. Testing began in the 1980s and will continue to at least 2010.

"Test data becomes especially critical when the space shuttle retires in 2010, and we need to determine which spare parts to store on the station to replace damaged parts," said Russell Graves, a Boeing associate technical fellow and the ISS orbital debris senior engineer. The research could also be used to design future spacecraft that better withstand meteoroid and debris impacts.

To better understand the potential damage, engineers at NASA's White Sands test facility in New Mexico fire special light-gas guns on space station test components that have been designated as having a higher probability of failure upon impact. The debris used for testing ranges from 0.5 to 6 millimeters (0.02 to 0.24 inches), which mimics items like paint flecks and circuit board components. "I was really surprised how much damage little pieces about the size of a ballpoint-pen tip can cause," said Mitch Bland, a Boeing spacecraft survivability engineer.

Debris testing allows engineers to modify some hardware designs to make them less susceptible to damage upon impact from orbital debris. "If I can make a minor design modification such as cable routing and increase its survivability from debris by a factor of two, and if it doesn't cost me much or add any weight, it's kind of a free upgrade," Graves said.

Engineers test a variety of materials and configurations to determine which are less susceptible to damage. They also test active components—such as wiring harnesses—to determine if and by how much impacts by orbital debris cause voltage spikes.

Graves said testing the effect of orbital debris impact will benefit more than the space station. "Testing on wire harnesses, heaters and other components will be useful to anyone who goes into space," he said. "One of the missions of the space station is to provide this kind of engineering data for future space vehicles, including the Boeing satellite development programs and NASA's Constellation project vehicles and lunar bases." ■

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Mitch Bland, a Boeing ISS survivability engineer, opens the chamber of a hydrogen gas gun at NASA's White Sands Test Facility in New Mexico following a recent orbital debris test on a space station component. The debris travels at speeds of more than 17,500 mph (28,200 kilometers per hour).