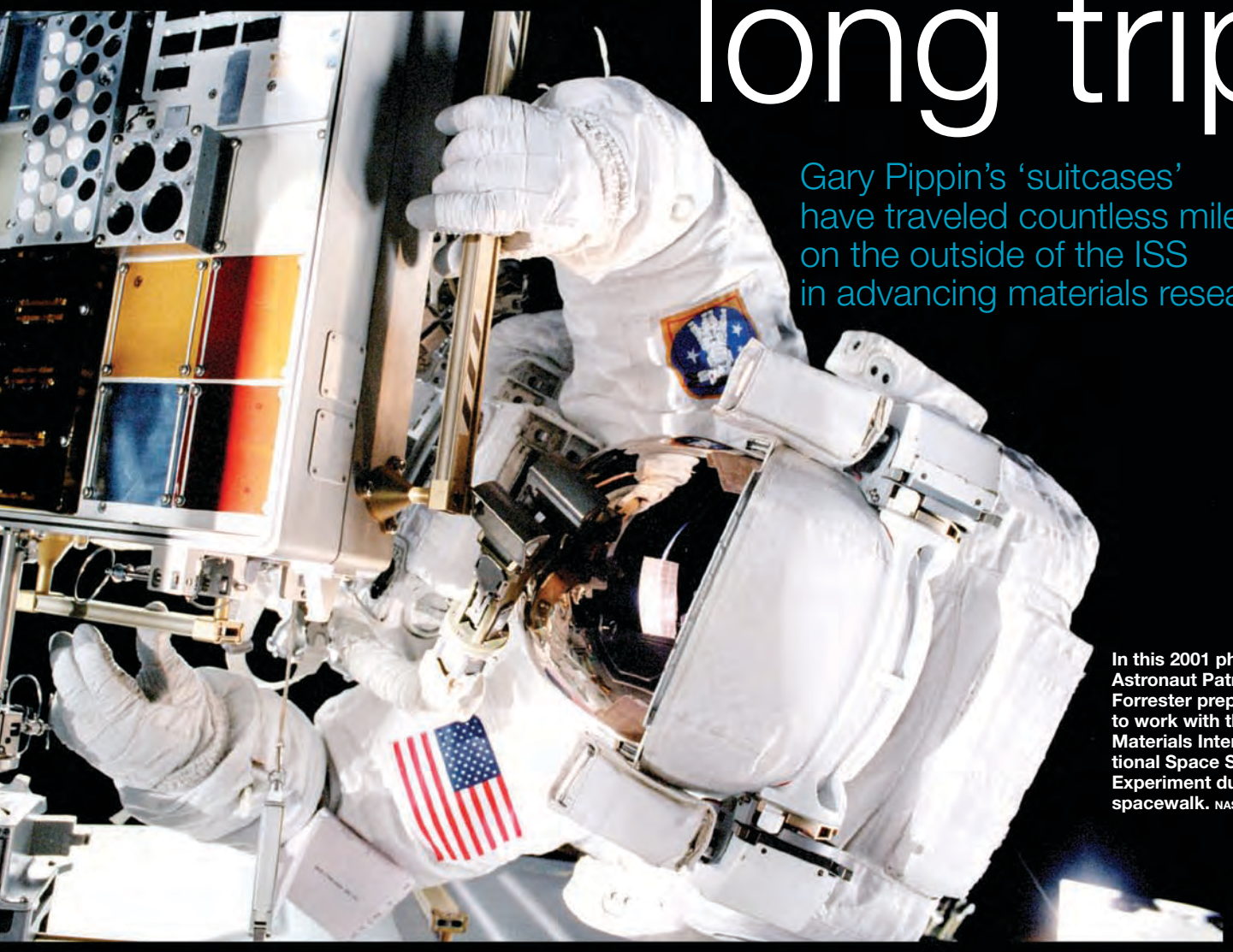
Pack for a long trip

Gary Pippin's 'suitcases' have traveled countless miles on the outside of the ISS in advancing materials research



In this 2001 photo, Astronaut Patrick G. Forrester prepares to work with the Materials International Space Station Experiment during a spacewalk. NASA

By Tom Koehler

How many miles do you estimate your suitcases have traveled over the years? Whatever the number, it's only a fraction of what Gary Pippin's have trekked.

For seven years, suitcase-sized containers packed by Pippin, a Technical Fellow in Boeing Phantom Works' Structural Technology organization, have been circling the globe while attached to the outside of the International Space Station.

Instead of clothes, Pippin's suitcases have been filled with test samples of materials as part of the Materials International Space Station Experiment (MISSE), a collaborative research effort involving Boeing, NASA, the U.S. Air Force and Navy, and other government, industry and university research organizations.

Thousands of samples of materials have been tested since MISSE began in August 2001. Among them: ceramics, composites, insulation, paint, active devices such as shutters and real-time data-recording instruments, and even biomaterials such as enzymes and cells.

The goal of exposing these materials in space, where harsh ultraviolet and particulate radiation, atomic oxygen and extreme temperature variation can cause them to degrade much more quickly than on Earth, has been to help engineers and scientists gain new insights into improving material durability and performance for future spacecraft. On Earth, the findings also could lead to improved coatings for aircraft, cars and buildings.

"Materials are really the enablers for all future technology," said Pippin, who helped create the MISSE team and has been a driving force in the experiments. "The advanced space vehicles of tomorrow will be crafted from materials with extraordinary resistance to the severe environment of space."

LATEST TEST IN A SERIES

MISSE is the latest in a series of materials-in-space experiments, dating back to tests on Skylab in the 1970s and continuing with NASA's Long Duration Exposure Facility (LDEF) and space shuttle experiments in the 1980s and 1990s.

LDEF was a bus-sized materials exposure experiment similar to MISSE. It was launched in 1984 and orbited for more than five years. When it was recovered, researchers were fascinated to find that some of the materials on board had eroded away entirely, while others had been reduced to shreds.

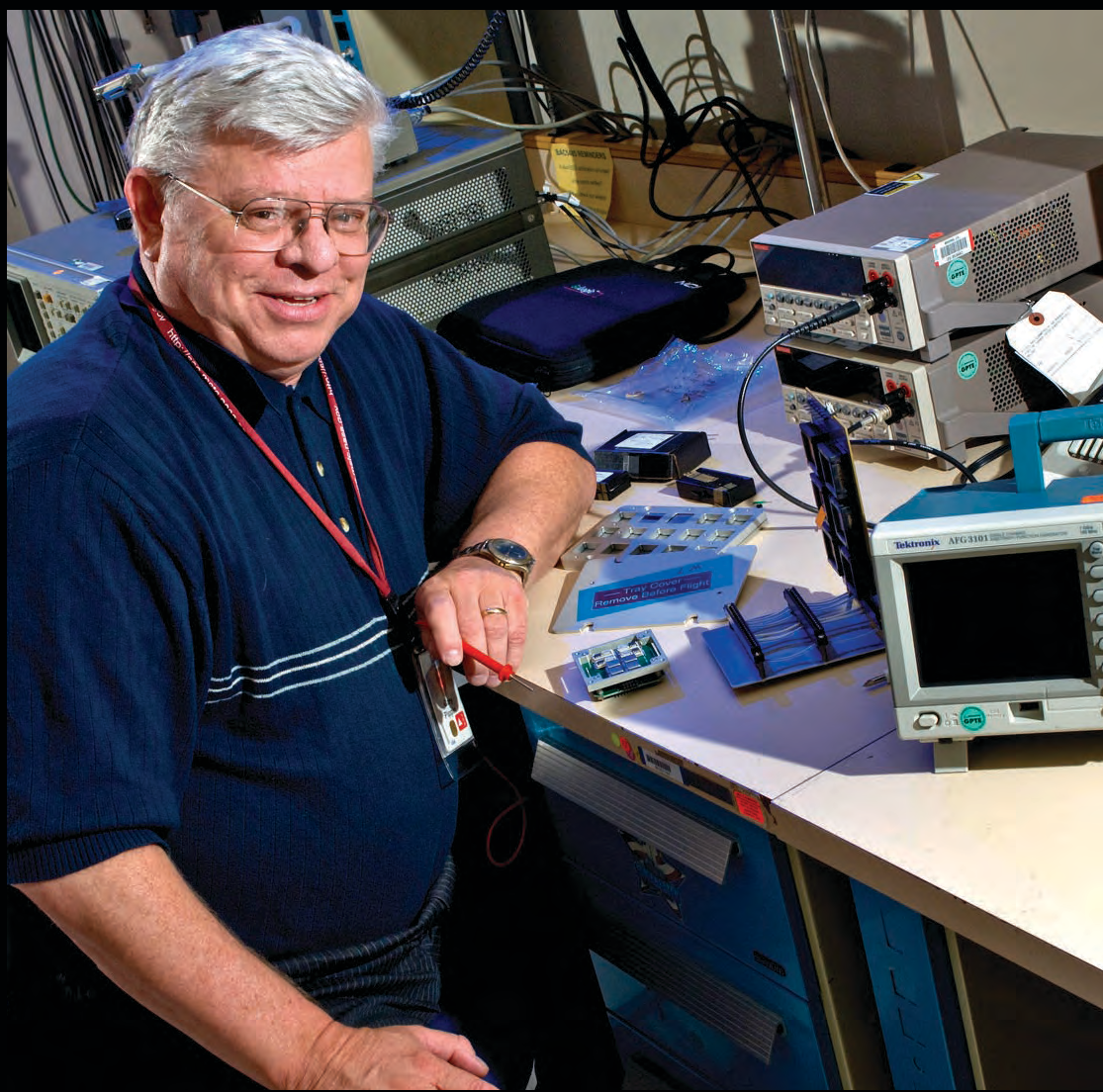
"We can simulate exposure in the laboratory, but nothing substitutes for space itself," said Pippin, indicating that atomic oxygen in low-Earth orbit in particular has a way of stealing carbon, hydrogen, nitrogen and other elements from the surface of materials.

When Space Shuttle *Endeavour* launched in March, more than 1,000 new materials were on board to be tested as part of MISSE-6, the sixth MISSE project.

Combined, MISSE-1 through -5 exposed more than 2,000 independent materials samples to the harshness of space and provided a wealth of information for the MISSE government-industry-university team. Created as long-duration experiments, MISSE-1 and -2 were returned to Earth in July 2005 after four years on orbit. Samples on MISSE-3, -4 and -5 were returned to Earth after one year on orbit. MISSE-7, planned for next year, will be connected to the power system on the ISS, with data and communication links.

"This work has been a great source of pride for me and has reflected well on Boeing as a leader in applied materials science research and engineering," said Pippin, a former professor at the Colorado School of Mines who's worked at Boeing since 1985. "MISSE has created opportunity for many small experiments that would not have otherwise taken place."

Pippin has co-authored more than 25 papers to share information collected by the MISSE packages with the aerospace community at large, and is quick to credit the cooperative nature of the MISSE team for its success. In particular, he cited Bill Kinard, a retired senior research scientist at NASA Langley Research Center in Virginia, for being instrumental in moving the research forward. In addition, within Boeing he cited the close working relationship between Phantom Works and Integrated Defense Systems, including work at the Boeing Radiation Effects Laboratory in Seattle.



Gary Pippin, at the Boeing Radiation Effects Laboratory in Seattle, has been a key researcher involved in the Materials International Space Station Experiment series since 2001.

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And when asked just how many miles he estimates those suitcases have flown, Pippin said, "The number starts with incredible and ends with wow!" ■

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