

March 2015

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## Dust-busting technology for moon, Mars exploration

**The Apollo astronauts** who walked on the moon in the late 1960s and early 1970s faced a dusty dilemma. Lunar dust clung to their spacesuits, earning them the moniker “the dusty dozen.”

The dust gummed up gauges, sun shades and tools that the moonwalkers carried.

As Apollo 17 commander Eugene Cernan put it during a debriefing back on Earth: “I think one of the most aggravating, restricting facets of lunar surface exploration is the dust,” he said, according to a transcript. The biggest problem, he said, was “its restrictive, friction-like action.”

Fast forward four decades, and technologists at the Kennedy Space Center’s Swamp Works facility are reporting good progress on the KSC Electrodynamic Dust Shield, an electric system they hope will tame the dust the next time astronauts walk on the moon or when they venture to Mars.

If all goes as planned, conductive threads would be added to the surface layers of astronaut spacesuits. Low-power AC current would course through these electrodes to produce electromagnetic fields — traveling electronic waves that would repel dust. If it turns out that shielding the entire suit is not feasible, another option would be to focus on keeping dust off critical components, such as the quick disconnects to gloves and boots. Transparent film versions are also in the works for solar arrays and spacecraft windows.

Developers are working on a version of the technology that will be



NASA researchers test an Electrodynamic Dust Shield in a vacuum chamber during reduced-gravity flights on a NASA aircraft.

made available to the companies participating in NASA’s Lunar Cargo Transportation and Landing by Soft Touchdown, or Lunar Catalyst, program, which aims to develop commercial robotic lunar landers. If a Lunar Catalyst spacecraft goes to the moon, a dust shield on a landing pad will attempt to repel the dust that arises as the craft lands.

The technology is based on an “electric curtain” concept developed by NASA in 1967 and further developed in the 1970s at the University of Tokyo. Prototypes of the shield are under study at KSC’s Electrostatics and Surface Physics Laboratory and have been evaluated on low gravity research planes.

“So far, our testing has shown the electrodes can remove most of the dust,” said Carlos Calle, founder and manager of the lab. “Thin wires are embedded in surfaces such as fabrics and can be made transparent on clear surfaces for optical devices, windows, visors, thermal radiators or solar panels.”

KSC’s dust shield was originally

developed to remove dust from the solar panels of Mars rovers and landers, but the technology has yet to be flown in space.

Karen Thompson, KSC’s chief, said the technology can be applied to habitat windows to ensure a non-dusty view.

Once the dust removal system circuitry is switched on “it just throws off dust and particles off the surfaces,” Thompson said at the NASA Innovative Advanced Concepts 2015 symposium in January.

Thompson described how the dust hampered the Apollo moonwalkers by sticking to their quick-disconnects. “They couldn’t connect them more than three times before they couldn’t make a seal anymore,” she said.

The dust shield technology might be applied to the whole spacesuit or on the locations of the quick-disconnects, Thompson said. It could keep dust and particles from being brought into habitation units.

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