Where do astronauts go when they need 'to go?'

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Alan Shepard became the first American to fly in space on May 5, 1961. Although NASA engineers had put considerable planning into his mission, dubbed Freedom 7, noticeably missing from this extensive preparation was a way for him to urinate in his spacesuit. During a lengthy launch delay, the inevitable happened, and Shepard's urine short-circuited his electronic biosensors. In less than a year, engineers had remedied this seeming oversight for John Glenn's Mercury orbital flight. The system developed for Glenn stood the test of time, remaining in use until the early days of the Space Shuttle program.

In a new article, Hunter Hollins of the National Air and Space Museum reviews the history of urine collection in space and the considerations necessary to accommodate this basic physiological function. That first successful urine collection device, used in 1962, has been on display at the National Air and Space Museum since 1976.

The new article, titled "Forgotten Hardware: How to Urinate in a Spacesuit," appears in the June 2013 edition of *Advances in Physiology Education*, a journal published by the American Physiological Society.

No need "to go?"

Hollins writes that though the general public was interested in how astronauts would tackle taking care of this basic need in space (a letter stored in NASA's Historical Reference Collection from a Pennsylvania

schoolgirl questioned where the first man in space would use the toilet), NASA's scientists and technicians seemed to ignored the problem before Shepard's mission. Combined with a lack of funding and little crosstalk between the organizations that would end up comprising NASA, scientists in the organization also assumed that the first astronauts would be able to "hold it" during their very short missions.

However, though Shepard's spaceflight was scheduled to last only 15 minutes, he spent eight hours in his spacesuit due to launch delays. During a four-hour stint on the launch pad, he relieved himself in the suit, damaging the electronic medical data sensors attached to his body.

After this understandable event, NASA researchers sought to design a way to contain urine in the inevitable event that future astronauts would need to go while wearing their spacesuits.

New device a relief for astronauts

Working around the spacesuit itself was one barrier to successful urine collection. The pressure suits worn by astronauts help keep their occupants alive during spaceflight by ensuring that pressures inside stay within a healthy physiological range. However, the bulky, uncomfortable suits left little room for devices to capture urine.

The first iteration of urine collection devices proposed for space were in-dwelling catheters, a tube threaded through the penis to collect urine continuously from the bladder. However, such catheters are extremely uncomfortable and greatly increase the risk of infection.

After Gus Grissom's Mercury-Redstone 4 mission followed Shepard's in 1961—in which Grissom urinated between two pairs of rubber pants—NASA researchers set about developing a more suitable urine collection device. They ended up basing theirs on the simple personal

urinals already available at the time for people with medical problems, such as impaired bladder control, or those without access to public urinals, such as police officers on a long shift.

In the end, the resulting device resembled a condom made out of more durable materials and open on one end, with a tube connected to a storage container. On Glenn's Mercury-Atlas 6 mission, he voided a full bladder into the new device, confirming its utility.

Tweaks still necessary

Astronauts regularly used this type of device with minimal modifications until the early days of the Space Shuttle program, Hollins writes. However, those and modern urine collection devices still aren't perfect. Hollins notes that in a survey done in 2010, the majority of U.S. Air Force pilots flying high altitude spy planes reported problems with the urine collection devices they wore, including poor fit, leaking, and skin damage from extended contact with urine.

"It is the job of the engineer/physiologist to ensure that the man-machine interface promotes the health and safety of the human body," Hollins says.

More information: advan.physiology.org/content/3 …/2/123.full.pdf+html

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