National Aeronautics and Space Administration

NASAfacts

International Space Station Robotic External Leak Locator

Batten down the hatches! Just like a ship, the International Space Station is carrying precious lives and cargo through an unforgiving environment - and its operators want to make sure that its critical resources, like the ammonia that helps keep the station's cooling system working properly, do not escape into space.

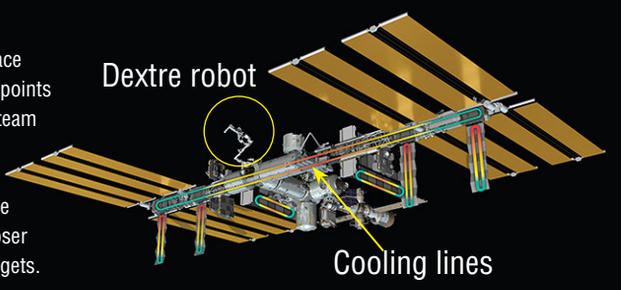
NASA's Robotic External Leak Locator (RELL) is a robotic, remote-controlled tool that helps mission operators detect the location of an external leak and rapidly confirm a successful repair. With RELL added to their tool chest, the space station team has another helper in their quest to keep the orbiting research center and all its onboard experiments operating at the right temperatures.

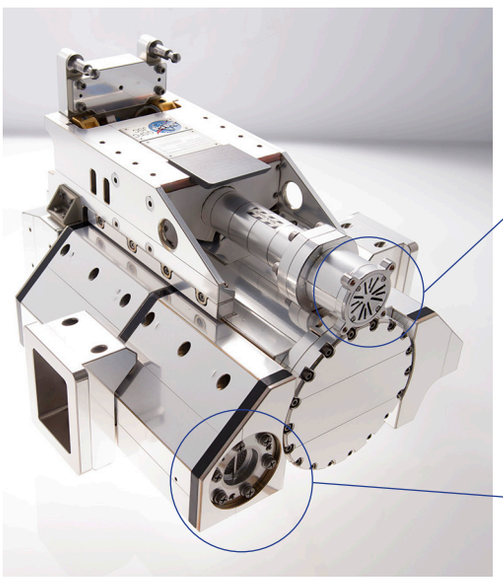
RELL launched to the International Space Station in December 2015. Since then, it has proven its worth, successfully locating a leak and significantly reducing astronaut time required outside of Station to inspect and repair the leak. The first RELL unit's success paved the way for a second, spare unit.

All You Need to Know about RELL

Ops plan: Controlled by a team at NASA's Johnson Space Center (JSC), the Canadian Space Agency's Dextre robot points RELL toward the station's cooling lines. A NASA ground team monitors from Earth.

That's when the game of "Hot and Cold" begins. When the tool is pointed at a leak, the tool's signal goes up. The closer the tool comes to the leak source, the higher the reading gets. Houston, we've found a leak.





Double the Instruments, Double the Detection

How the tool works: Two instruments working in sync give RELL its ammonia-detecting superpowers.

Mass spectrometer: Designed for use in a vacuum, this device measures the number of molecules present in any molecular mass to create a "mass spectrum" reading. From this spectrum, analysts can distinguish between gasses that are naturally present in the orbital environment, versus ammonia – which could only be coming from the space station itself. Far more sensitive than a human nose, the instrument can detect a leak from a football field's length away.

Ion vacuum pressure gauge: True to its name, this device measures total pressure in space. It cannot distinguish between different gas molecules, but it can sniff for a large leak up close – and locate a leak's position to within a few inches.

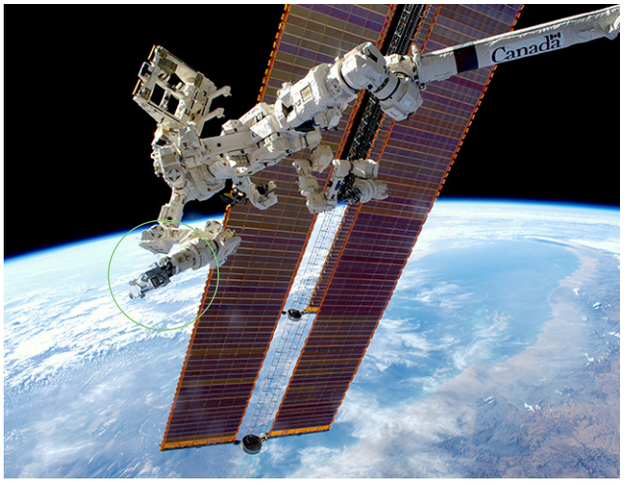
Helping Space Station Operate Optimally

Just as coolant in your car is used to cool its engine, ammonia is circulated through a huge system of pumps, reservoirs and radiators on the space station to cool all of its complex life support systems, spacecraft equipment and science experiments. This coolant system contains thousands of feet of tubing and hundreds of joints. Throughout its lifetime, this system has experienced tens of thousands of thermal cycles orbiting through night and day and the normal wear and tear that comes with over a decade in service. The space station also has to contend with micrometeoroids: tiny objects whizzing through space at speeds that can easily exceed 20,000 miles per hour – and that can cause unwanted, microscopic holes in spacecraft equipment.

NASA astronauts during a May 2013 leak repair spacewalk.

Over time, there have been intermittent component failures and leaks on the ammonia cooling loop. Astronauts have undertaken spacewalks to help diagnose, troubleshoot and replace components within the complex active thermal control system. Without a way to robotically locate leaks with high accuracy, astronauts have used spacewalk time to inspect and isolate a potential leak site before addressing the problem at hand.

Astronaut Kate Rubins loading the Robotic External Leak Locator for deployment into space.



The Robotic External Leak Locator on the end of the Dextre robot in February 2017.

A Tale of Two Centers

Working together, the Engineering Directorate at JSC and the Satellite Servicing Projects Division (SSPD) at NASA's Goddard Space Flight Center (GSFC) developed RELL for the ISS Program so that astronauts could dedicate their resources to other duties.

With a wide array of technology development experts, designers, analysts, project engineers and project managers in house that have developed ISS systems and supporting hardware, the JSC Engineering Directorate seeks to support the ISS program by providing solutions like RELL that can enhance the ISS mission and systems reliability.

The SSPD team is driving the cutting edge in new NASA servicing technologies. In creating RELL, SSPD leveraged the experience they gained building and executing the Robotic Refueling Mission (RRM), an experiment on space station that is successfully demonstrating tools, technologies and techniques to service spacecraft that were not designed for in-flight repair.

Beyond ISS

The benefits of leak detection have already been proven on Station, and this ability could be similarly helpful for long-term human habitation on the lunar Gateway, a lunar habitat, and perhaps one day a crewed voyage to Mars. Furthermore, at its core, RELL is a robotics-controlled characterizer of the local environment. This same ability could be used to determine the composition of nearby environments for exploration on the lunar surface, and for scientific and resource utilization purposes.

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