NASAfacts

International Space Station Robotic External Leak Locator

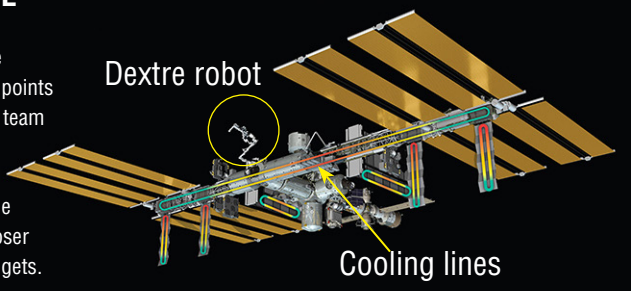
Batten down the hatches! Just like a ship, the International Space Station is carrying precious lives and cargo through an unforgiving environment – and its operators want to make sure that its critical resources, like the ammonia that helps keep the station's cooling system working properly, do not escape into space. NASA's International Space Station Robotic External Leak Locator (IRELL) is a new robotic, remote-controlled tool that could help mission operators detect the location of an external leak and rapidly confirm a successful repair. With IRELL 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.

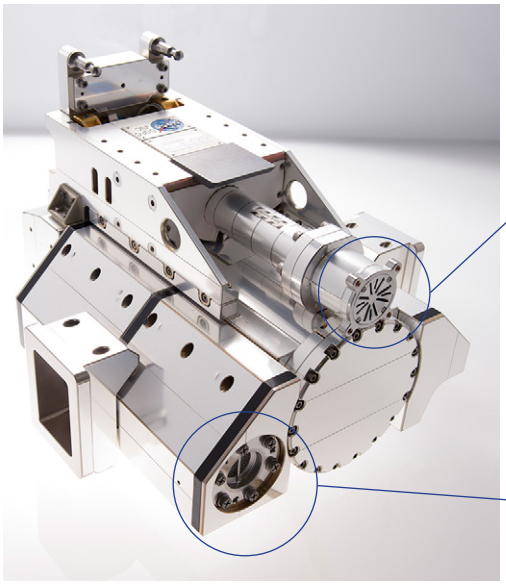
After it arrives at the space station, IRELL will go through a series of tests to evaluate its performance and determine its capabilities as a leak locator for the orbiting space laboratory. If IRELL's concept is proven successful, the robotic tool could potentially greatly reduce the time that spacewalking astronauts spend searching and repairing external leaks on the station. Future versions of IRELL could potentially support other programs and vehicles operating in low-Earth orbit and beyond.

All You Need to Know about the IRELL

Ops plan: Controlled by a team at NASA's Johnson Space Center (JSC), the Canadian Space Agency's Dextre robot points IRELL 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 the IRELL 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.

Engineers at Goddard prepare the IRELL for flight.

The Mission Control room at Johnson from which Dextre operations are commanded.

A Tale of Two Centers

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

The JSC Engineering Directorate houses many of the space station subsystem managers that are responsible for keeping the immense, orbiting research asset operating safely and reliably for global use. 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 Engineering Directorate seeks to support the ISS program by providing solutions like the IRELL that can enhance the ISS mission and systems reliability.

The SSCO team is driving the cutting edge in new NASA servicing technologies. In creating the IRELL, SSCO 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.

Putting IRELL to Work

The IRELL is launching to the space station aboard the Fourth Orbital ATK Commercial Resupply Services Flight scheduled for December 2015. After its arrival, robot controllers at Johnson – known as the "ROBO team" – will command the remotely controlled Dextre to pick up the tool for an initial set of tests. When not in use, the instrument will be stored within the space station.

The first IRELL was lost during a launch failure in the fall of 2014. A second IRELL was prepared for the 2015 launch.

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