Testing: Space-bound US-European water mission passes finals

October 4 2022, by Carol Rasmussen

The SWOT spacecraft is seen during testing at a Thales Alenia Space facility near Cannes, France. Credit: CNES/Thales Alenia Space

Before any NASA mission is launched, the spacecraft goes through weeks of harsh treatment. It's strapped to a big table that shakes as hard as the pounding of a rocket launch. It's bombarded with louder noise than a stadium rock concert. It's frozen, baked, and irradiated in a vacuum chamber that simulates the extremes of space. The Surface Water and Ocean Topography mission (SWOT), a collaborative U.S.-French mission to monitor all the water on Earth's surface, has passed these major tests. Now, except for a few final checks, SWOT is ready for its December launch.

Some of SWOT's engineers at NASA's Jet Propulsion Laboratory in Southern California have invested almost a decade in designing, building, and assembling this complex mission. Watching the instruments they've labored over go through the latest round of tests has been stressful, but the team has taken the process in stride. That's because every part of SWOT, down to nuts and bolts, had been tested multiple times before the satellite entered the thermal vacuum chamber for the last time. The engineers say the earlier tests produced far more anxiety.

Phoebe Rhodes-Wickett, a mechatronics engineer at JPL, has spent a quarter of her life working on SWOT. She initially focused on a small component used to deploy the antennas on the spacecraft's main instrument. "The first time I tested my mechanism, I was terrified," she said. About as big as a box of tissues, the component was tested on a full-size shaker table. "It was just this little mechanism sitting by itself. The test is loud, and you can see the mechanism moving," added Rhodes-Wickett. "We had a failure in our first round of testing. We had to redesign and retest the mechanism in a few months' time to get it certified as spaceworthy."

After passing that retest, the mechanism was connected to larger and larger systems that were finally integrated into the complete SWOT spacecraft. Every phase of spacecraft assembly creates new connections and presents another avenue for human error to creep in, so it ends with another round of tests. Rhodes-Wickett's mechanism passed vibration testing three more times since that first experience. "Each test you pass is a relief," she said, "but by the time you get to the third or fourth test, your stress level is much lower."

The mechanism is part of SWOT's new radar instrument, which is the first of its kind in space. The Ka-band Radar Interferometer, or KaRIn, has two radar antennas mounted on mechanical arms. Once SWOT is in orbit, the arms will unfold from opposite sides of the spacecraft and extend until the antennas are almost 33 feet (10 meters) apart. Just as the space between your eyes helps you to judge distance and depth better, the space between KaRIn's two antennas helps the instrument reveal more details about Earth's water. But if the process isn't almost perfect—if the mechanical arms don't extend fully or the antennas are misaligned by even a few thousandths of a degree—KaRIn can't make the hoped-for measurements.

Risky business

"It's a unique part of a career at NASA that we're always trying to build stuff that's never been built before," said JPL's Eric Slimko, chief mechanical engineer on SWOT. That means every NASA payload starts with an unknown risk factor. Most missions gain some sense of the risk level by deploying prototype instruments on aircraft and in labs, but there's still the (literally) sky-high additional challenge of adapting the technology to survive launch and work in space. "We don't have the capability of eliminating all that risk by an analysis on a piece of paper," he said. "We have to test it." Even off-the-shelf parts are certified.

Designing tests that could prove the folding arm and antenna assembly will perform as well in orbit as they do on Earth was "very, very challenging," Slimko said. "For one thing, we can't turn off gravity. But we developed a verification program that, even though we cannot recreate the exact flight environment on the ground, we still have complete confidence that it will work in space."

Carrying out the program required dozens of JPL engineers to spend weeks or months at the Thales Alenia Space facility in Toulouse, France, working with colleagues from the French space agency Centre Nationale d'Études Spatiales (CNES) to complete the series of tests as the spacecraft was assembled. The spacecraft includes hardware from not only CNES and NASA but also the United Kingdom and Canadian space agencies, with each team monitoring the performance of its own parts during testing.

Now almost all that remains is the ultimate test: the launch itself. The engineers are more than ready. "It's fun to have a baby that you literally dreamed up, helped to grow, and now you're walking it to the finish line," Rhodes-Wickett said. "It's really exciting to see something that you've poured so much time and effort into go on and make a difference in the world."

Provided by Jet Propulsion Laboratory

Citation: Testing: Space-bound US-European water mission passes finals (2022, October 4) retrieved 13 June 2024 from https://phys.org/news/2022-10-space-bound-us-european-mission.html