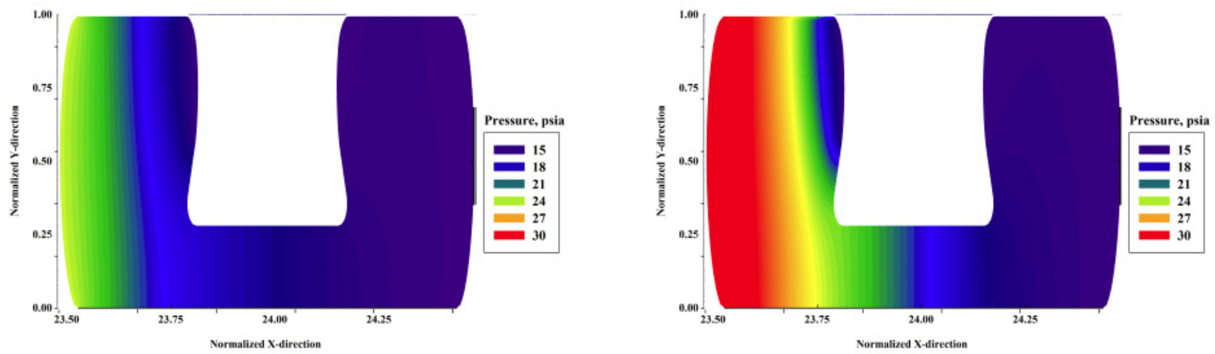
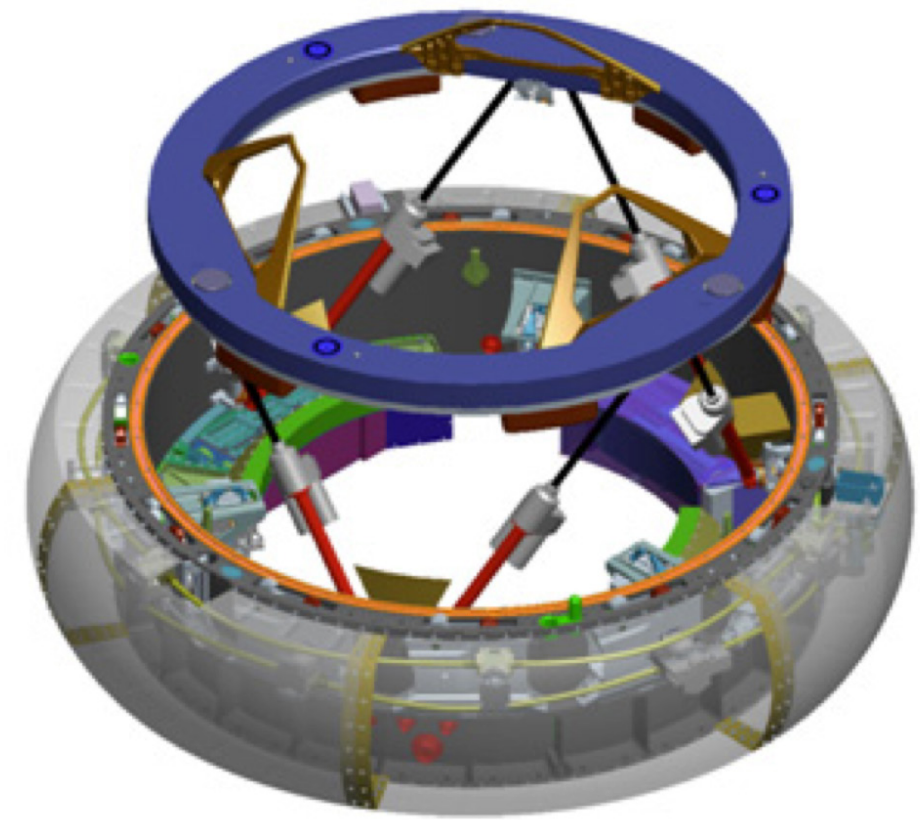


(a) 10 psid (b) 20 psid



(Right) An analysis of air leakage of main interface seals – shown here as an orange ring – used in NASA's International Low Impact Docking System (iLIDS). (above) Characterization of computational pressure profiles of a potential main interface seal for docking at the International Space Station and other new spacecraft.

ELASTOMERIC SPACE SEALS

Garafolo studies approaches to test docking systems

A University of Akron researcher is designing computer prediction models to test potential new docking seals that will better preserve breathable cabin air for astronauts living aboard the International Space Station and other NASA spacecraft.

Nicholas Garafolo, Ph.D., a research assistant professor in Akron's College of Engineering analyzed a two-piece elastic silicone – or elastomer – seal, using systems at the Ohio Supercomputer Center. His model simulated air leakage through the elastomer, taking into account the effects of gas compressibility and variable permeability.

"Recent advances in both analytical and computational permeation evaluations in elastomer space seals offer the ability to predict the leakage of space seals," said Garafolo. "Up until recently, the design of state-of-the-art space seals has relied heavily on intuition and costly experimental evaluations. My research evaluated the performance of the compressible permeation approach on a space seal candidate."

Garafolo serves on a research team tasked with testing polymer/metal seals being considered for future advanced docking and berthing systems. The university researchers work with partners in Cleveland, Ohio, at NASA's Glenn Research Center, which is responsible for developing the main interface seals for the new International Low Impact Docking System. NASA has been developing low-impact docking seals for manned missions to the International Space Station, as well as for future exploratory missions. Common to all docking systems, a main interface seal is mated to a metallic flange to provide the gas pressure seal.

To establish an analytical understanding of space seal leakage and construct their computational prediction tool, Garafolo and his colleagues modeled how air leaked into and through the elastomer seal, while taking into account the effects of gas compressibility and the variability of permeation on air pressure. The research team's first evaluations showed significant correlations between the experimental values and the computer modeled results.

For pressure differentials near operating conditions, the leak rates determined by the model accurately reflected the experimental results, within the bounds of uncertainty. For pressure differentials exceeding normal operating conditions, the differences between the experimental results and computational numbers were not quite as close as expected. The larger differences in the leak rates, however, were attributed to extrapolation errors of the model parameters.

Project lead: Nicholas Garafolo, University of Akron
Research title: An evaluation of the compressible permeation approach for elastomeric space seals
Funding source: National Aeronautics and Space Administration
Web site: http://bit.ly/OSC-RR-Garafolo