

Fluid Dynamics and Multiphase Flow Research and Development



Southwest Research Institute®

San Antonio, Texas



Fluids Technology at SwRI

For more than 50 years, Southwest Research Institute (SwRI®) has provided state-of-the-art, comprehensive solutions to fluid dynamic and multiphase flow problems. The Institute offers a variety of onsite resources, as well as field capabilities, that provide a comprehensive set of tools to analyze and solve an assortment of fluid problems. SwRI has performed fluids research for industries ranging from oil and gas processing to space engineering to food processing.

SwRI has provided fluid dynamic and multiphase flow solutions for the oil and gas industry for five decades. Details on applied research for **Oil and Gas Drilling, Completion, and Production** are located on pages 4 and 5.

The study of fluid behavior in microgravity environments presents unique and significant challenges. The Institute has been involved in an array of research for the space industry. Information about **Space Fluids Engineering** at SwRI can be found on page 6.

Valves, gaskets, and other piping components require rigorous testing to ensure their integrity in various environments. The Institute has a variety of onsite facilities to test flow components in accordance with an array of standard test procedures. Details of the Institute's capabilities for **Flow Component Testing** are on page 7.

Southwest Research Institute

Founded in 1947 as an independent, nonprofit research and development organization, Southwest Research Institute provides a significant research, engineering, and testing resource for industry, business, and government. The Institute uses a multidisciplinary, integrated approach to solving complex problems in science and applied technology.

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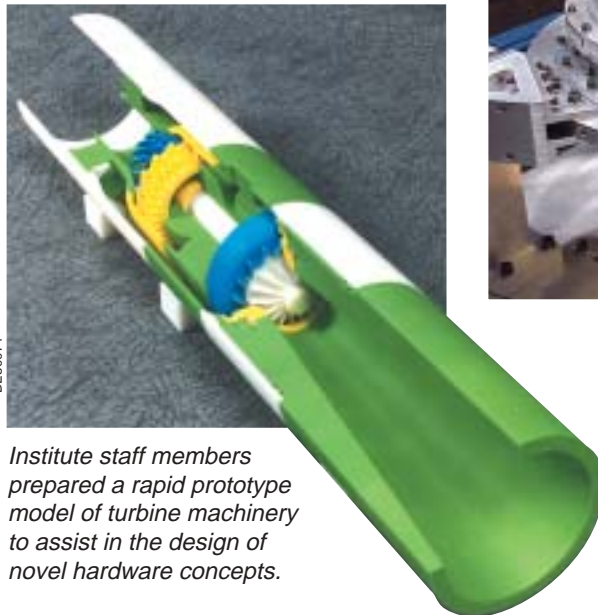
Institute researchers measured flow velocity of a catalytic converter with laser Doppler velocimetry. Such experimental setups allow for noninvasive flow measurement, and serve as an example of Institute capabilities for studying fluid dynamic problems.

The Institute offers a variety of onsite facilities for flow research, development, and evaluation. These resources have been used to analyze such problems as gas metering, hydrate formation, and industrial process heat transfer. Customizable test parameters are available to meet desired conditions.



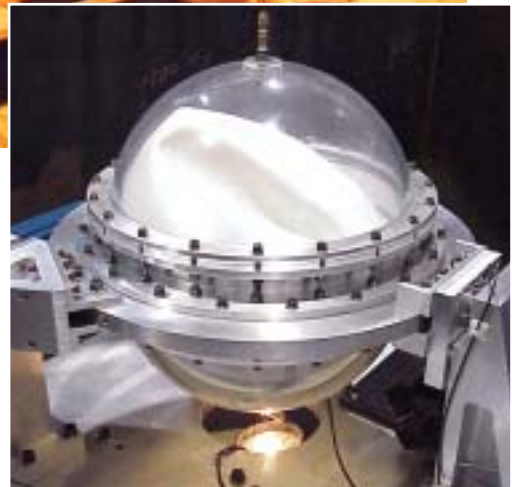
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SwRI engineers developed this apparatus as part of an experimental research program investigating microgravity fluid dynamics. SwRI has advanced the cutting edge of fluid dynamic research for several decades. Institute staff members have utilized resources from large piping facilities to small bench scale tests to provide solutions.



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Institute staff members prepared a rapid prototype model of turbine machinery to assist in the design of novel hardware concepts.



D014272

The Institute operates a spinning sloop test rig to investigate the stability of satellites experiencing liquid motion excitation. The apparatus, designed and constructed at SwRI, simulates spinning conditions experienced by satellites during deployment and operation.

Oil and Gas Drilling, Completion, and Production

The Institute has provided state-of-the-art technical solutions to fluid dynamics and multiphase flow problems for the oil and gas industry for more than 40 years. SwRI engineers have performed a wide variety of projects ranging from efficient and safe extraction of fossil fuels to the delivery of oil and gas goods to consumers. Institute staff members use a combination of analytical tools, computer modeling, laboratory experiments, and field testing to support the industry.

SwRI has provided numerous technical solutions to problems arising in **drilling** and **completion** operations. In addition to modeling and testing, Institute researchers design and fabricate hardware for an array of applications. Investigations have been performed on topics including:

- Sand control screen plugging and erosion testing
- Gravel packing methods
- Novel drilling fluids
- Prototype design and hardware fabrication
- Downhole equipment design and delivery
- Deviated wellbore cleaning
- Fall velocities of drill cuttings

SwRI has also provided a diverse spectrum of **production** solutions, including work in the following areas:

- Multiphase and wet gas metering
- Hydrate blockage and remediation
- Flow assurance
- Separation and mixing
- Multiphase pump testing
- Subsea pipeline design



Institute-developed tests determine the erosion resistance of sand control screens used in oilfield applications. SwRI capabilities include both air-sand and water-sand systems for simulating appropriate downhole conditions.



Researchers remove natural gas hydrates from a pipeline during a field test. Using the test results, Institute engineers developed hydrate remediation techniques applicable to land-based and offshore operations.

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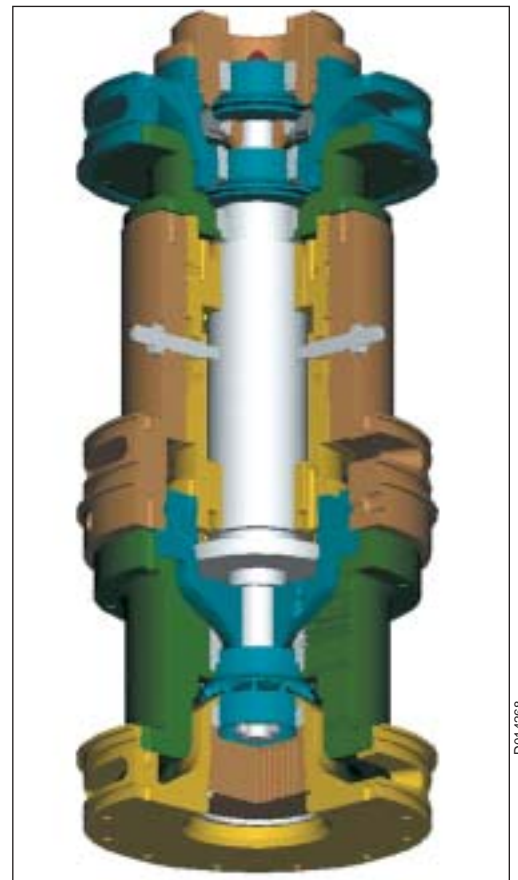


High pressure and near-freezing temperatures in deep-water environments may result in hydrate and paraffin blockages in pipelines, restricting oil and gas flow. This multiphase flow loop at SwRI is used to simulate field conditions for flow assurance studies and other multiphase flow research.



DE136861

SwRI engineers used these material samples to simulate the porosity of rock in the evaluation of novel drilling fluids developed at the Institute.



D014268

To increase oil production in wells by using downhole machinery to separate, compress, and reinject gas, SwRI engineers performed design and test work on this subsurface processing and reinjection compressor.



DE105245

Institute engineers developed and patented a dispensing method for the delivery of compressed natural gas for commercial vehicle use.

Space Fluids Engineering

Institute scientists and engineers have studied the behavior of fluids in microgravity environments for an array of applications. This work has supported functions such as space vehicle operation and satellite deployment. SwRI has explored space fluid behavior using analytical tools, ground article testing, and flight-test experiments. Institute engineers have conducted extensive research in this field, including areas such as:

- Mass gauging
- Propellant properties
- Liquid sloshing in launch vehicles
- *In-situ* propellant development
- Gas compression in microgravity
- Space article re-entry breakup modeling
- Satellite tank liquid acquisition device development
- Liquid motion properties



DE139577

SwRI engineers designed a compression mass gauge to measure the quantity of cryogenic liquid propellants in a spacecraft tank. This gauge has proven to be more effective than conventional methods of determining liquid levels in microgravity.



D014269



D014267

Designed and fabricated by SwRI engineers, a liquid motion experiment (top center and inset) was tested aboard the space shuttle Atlantis. The experiment investigated the motion of fluids in microgravity yielding results vital to the design of space vehicles and satellites.



DE80074

SwRI engineers developed this waste gas compressor for the space station program. Tests performed at the Institute provided rigorous validation of seal life in the compressor configuration to ensure long-term functionality in space environments.

Flow Component Testing

For almost 30 years, the Flow Component Testing Facilities (FCTF) at SwRI has provided independent, third-party testing to ensure the safety and operability of piping components. The FCTF is accredited by the American Petroleum Institute to perform certification testing for surface and subsurface safety valves. Standard and custom testing are available for the following verification needs:

- Subsurface, surface, and underwater safety valves
- Fire testing of valves, gaskets, and other piping components
- Cryogenic leakage testing
- Flow coefficient determination for gas and liquids
- Seals and high-pressure, high-temperature sliding sleeve testing
- Gasket performance evaluation

Institute engineers design and conduct test procedures to aid manufacturers in the development and evaluation of new products. SwRI serves both domestic and international clients. Additional information on the Institute's flow component testing is available at fctf.swri.org.



D014264

The FCTF at SwRI conducts standard and specialized testing to evaluate valves, piping, gaskets, and seals.



D013956

The Institute uses this test stand to conduct API verification testing of subsurface safety valves, which ensures the valves will operate properly under field conditions. Facilities that support this testing include capabilities to conduct tests that require high-pressure water, flowing a sand slurry, high gas flow rates, and elevated temperatures and pressures.



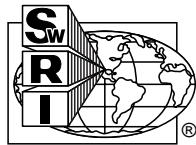
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SwRI performs standard and customized fire evaluation of valves, gaskets, and other piping components to ensure safe operation of piping components during and after a fire.



Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres and provides nearly two million square feet of laboratories, test facilities, workshops, and offices for more than 2,800 employees who perform contract work for industry and government clients.

*We welcome your inquiries.
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