

## Hydrogen and Alternative Fuels Hazards Evaluation

Southwest Research Institute® (SwRI®) provides the highest quality research associated with alternative fuels, gases and vapors. SwRI's experienced, multidisciplinary technical and support staff members are experienced in construction, machining, electronics, gas analysis and instrumentation. State-of-the-art resources include:

- ❑ Fire research facilities (large and small scale)
- ❑ Explosive and propellant test ranges
- ❑ Vapor and dust explosion facilities
- ❑ Computer modeling software

### Standard Testing

SwRI assisted the U.S. Department of Transportation in development of the Federal Motor Vehicle Safety Standard FMVSS 304, Compressed Natural Gas Fuel Container Integrity, and continues to assist organizations in development of test methods. Staff members perform tests for commercial clients to standards that include:

- ❑ FMVSS 304, ISO 11439, NGV-2 – Compressed natural gas fuel container evaluations
- ❑ ISO 15869, HGV – Gaseous hydrogen and hydrogen blends (compressed) vehicle fuel tank evaluations
- ❑ ISO 16111, Hydrogen absorbed in reversible metal hydride
- ❑ 33CFR154, MSC/Circ.677, ASTM F1273, UL 525, UL 1111 – Deflagration, detonation, end of line, and tank vent flame arrester evaluations
- ❑ GMN5354TP, E85 (ethanol/gasoline blend) – Fuel system flame arresting capability
- ❑ Liquid hydrogen storage tank evaluations

### Explosion Evaluation and Mitigation

SwRI is experienced in assessing the effects of hydrogen, natural gas, propane and other flammable chemical release fires and explosions on various assemblies or structures. Measurements on small-scale samples to complete mockup structures include:

- ❑ Dispersion of flammable gases and vapors
- ❑ Time to ignition
- ❑ Heat release rate
- ❑ Blast pressures
- ❑ Damage

Research programs can be developed to analyze the hazards associated with the storage and release of small to large quantities of oxidizing chemicals. Ventilation, passive and active fire protection, and ignition prevention techniques can be developed and tested for their effectiveness on an extensive variety of hazards.

### Facilities

SwRI has extensive facilities for the simulation and measurement of small- to large-scale fires, blasts and explosions. Storage facilities can contain thousands of gallons of liquid fuels, vaporizers for the rapid release of liquefied gases, 2,000 gallons of propane, and include a 50,000-cubic-foot hydrogen trailer. An on-site explosion containment facility allows cost-effective performance of moderate-level explosion research. A remote test site allows the safe simulation of severe explosive events.

Blasts can be measured and viewed with an extensive array of equipment, including:

- ❑ High-speed blast pressures and sound levels up to 100 kHz
- ❑ High-speed strain and acceleration up to 100 kHz
- ❑ High-speed color video in excess of 3,000 frames per second
- ❑ Infrared and ultraviolet imaging



*Catastrophic failure of a compressed hydrogen cylinder*



*Infrared view of hydrogen ignition inside an engine compartment*





Ignition of hydrogen inside an engine compartment

## Previous Research Programs

SwRI has performed extensive research programs and published numerous papers evaluating hazards associated with alternative fuels. Examples include:

- ❑ Induced Catastrophic Failure Analysis of a 5,000-psig Type IV Hydrogen Cylinder\*
- ❑ Ignition of Underbody and Engine Compartment Hydrogen Releases\*
- ❑ Vehicle Bonfire to Induce Catastrophic Failure of an Installed Hydrogen Cylinder\*
- ❑ E-Diesel Fuel Tank Flame Arrester Evaluation\*\*

\*Paper available from the Motor Vehicle Fire Research Institute (MVFRI) and the Society of Automotive Engineers (SAE).

\*\*Paper available from the National Renewable Energy Laboratory (NREL).



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 in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for more than 3,300 employees who perform contract work for industry and government clients.

**We welcome your inquiries.**  
**For additional information, please contact:**

**Alexandra Joyce**

Engineer

(210) 522-6423

[alexandra.joyce@swri.org](mailto:alexandra.joyce@swri.org)

**Fire Technology Department**  
**Chemistry and Chemical Engineering Division**

Southwest Research Institute  
6220 Culebra Road (78238-5166)  
P.O. Drawer 28510 (78228-0510)  
San Antonio, Texas

**[fire.swri.org](http://fire.swri.org)**



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and the public through innovative  
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