

# Composite Tank Technologies

*With improved structural integrity*



Innovators at **NASA's Marshall Space Flight Center** have developed several new designs and methods of fabrication for composite and composite-over-wrapped tank vessels that help significantly improve their structural integrity against impact, abrasion, harsh environments, and fire. Several embodiments of this technology portfolio also enable production of composite tanks capable of transporting liquefied natural gas or other cryogenic liquids. These innovations are applicable to important aerospace needs, including propulsion systems as well as new and growing fields such as natural gas transportation.

## Benefits

- **Strong:** Enables improved structural integrity for vessels that can withstand impact, fire, and other harsh conditions
- **Versatile:** Suitable for containing a wide range of materials—from high-pressure gases to liquid cryogen—over a wide range of temperatures
- **Lightweight:** Provides improvements that allow vessels to be lighter than previously available tanks of comparable strength
- **Scalable:** Offers designs and methods that can be easily tailored to large structures and easily handle tooling and materials changes



## The Technology

### What it is

Marshall researchers have achieved and demonstrated technologies that increase the performance and robustness of composite tanks and pressure vessels. Their innovations have been applied to lined (metallic and non-metallic) composite over-wrapped pressure vessels and to all-composite tanks and pressure vessels. The methods involve a unique combination of fibers and resin systems that result in superior resistance to impact damage and extreme environments while remaining lightweight and cost effective.

Further enhancements are ideal for the containment of compressed natural gas and liquefied natural gas. For example, custom-tuned materials applied to the vessels enhance the ability to contain cryogenic fluids and perform well under extreme environments. The addition of insulation and protective coatings augment the long-term storage of cryogenic fluids. The composite tank technologies have demonstrated superior performance in U.S. Department of Transportation (DOT) bonfire and ballistics tests.

### Why it is better

Many currently available composite vessels are easy to damage by impact and do not perform well in high-temperature or cryogenic environments. Auto industry standards for natural gas and hydrogen containment are strict, and most current tank technologies have difficulty meeting them. In contrast, the use of Marshall's technologies allows them to surpass the minimum industry standard requirements. For example, composite vessels pressurized with liquid nitrogen and impacted with a 50-caliber, armor-piercing bullet withstood fragmentation in tests. Other vessels using Marshall's technologies demonstrated the same burst pressure as a non-fire-exposed vessel after undergoing an entire bonfire test.

### Patents

Marshall has received patent protection for these technologies (U.S. patent Nos. 6,158,605; 6,193,917; and 6,953,129), and is seeking additional patents.

## Partnership Opportunities

These technologies are part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to inquire about the licensing possibilities for Marshall's composite tank technologies (MFS-31379-1, MFS-31379-2-DIV, MFS-31727-1, MFS-31838-1, MFS-32024-1, and MFS-32390-1) for commercial applications.

## Commercial Applications

- Pressure-fed propulsion systems
- Natural gas and other fuel transportation
- Self-contained breathing apparatus (SCBA) tanks for emergency responders
- Storage tanks for fuels, gases, and cryogenic fluids

## For More Information

If you would like more information about these technologies, please contact:

Sammy A. Nabors  
Manager, Technology Commercialization and Licensing  
NASA's Marshall Space Flight Center  
256-544-5226  
sammy.nabors@nasa.gov

Karen Hiser  
Senior Consultant  
Fuentek, LLC  
919-249-0327  
nasa.msfc@fuentek.com

[www.nasasolutions.com](http://www.nasasolutions.com)

National Aeronautics and Space Administration  
George C. Marshall Space Flight Center  
Huntsville, AL 35812  
[www.nasa.gov/centers/marshall](http://www.nasa.gov/centers/marshall)

[www.nasa.gov](http://www.nasa.gov)