Space Shuttle
Technology Summary

Super Lightweight External Tank

The gigantic rust-colored External Tank is the largest element of the Space Shuttle at 27.6-feet (8-meters) wide and 154-feet (46.9-meters) tall – 34 feet (10.4 meters) longer than the distance of Orville Wright's first flight made in 1903.

During the first 8 1/2 minutes of launch, the external Tank feeds 535,000 gallons (2,025,000 liters) of liquid propellants – hydrogen and oxygen – to the Shuttle's three main engines, powering the Shuttle into space. Termed the structural backbone of the Shuttle system – which includes the Orbiter and two Solid Rocket Boosters – the tank withstands 7 million pounds (31.1 million newtons) of thrust exerted at launch.

The External Tank is the only Space Station component that cannot be reused.

The present version – the third generation – is the super lightweight tank, first flown on STS–91 in June 1998. The tank, primarily made of an aluminum-lithium alloy, is 7,500 pounds (3,402 kilograms) lighter than the previous design, the lightweight tank.

The stronger, lighter alloy – and other weight-saving design changes – places the new super lightweight tank at about 58,500 pounds (26,535 kilograms) empty, and 1.6 million pounds (725,000 kilograms) when filled with propellants.

The lighter tank enables the Space Shuttle to carry heavier components, such as those being used to assemble the *International Space Station*.

The original version of the External Tank weighed 76,000 pounds (34,470 kilograms). A redesign dropped the weight down by 10,000 pounds (4,536 kilograms), resulting in the lightweight tank. Each pound removed from the External Tank means either an extra pound of payload in the Orbiter's cargo bay, or it enables the Shuttle to go to a higher orbit.

The lightweight tank – the second-generation tank – was introduced on the sixth Shuttle mission (STS–6) in 1983.

The original version of the External Tank was made of aluminum alloy 2219. In 1986, Lockhead Martin Laboratories in Baltimore, Md., undertook the challenge to develop a high strength, low-density replacement for the 2219 alloy – while retaining its excellent welding characteristics and resistance to fractures when exposed to extremely low temperatures. The result was a family of aluminum-lithium alloys called Weldalite®, from which the 2195 alloy was selected for the super lightweight tank.

The 2195 aluminum-lithium alloy is 30 percent stronger and 5 percent less dense than the original 2219 alloy used. It can be welded and withstands fractures to a temperature of minus 423 degrees Fahrenheit (minus 252.8 Celsius) – the temperature at which the liquid hydrogen propellant is stored on board.

Al-Li 2195 is composed of 1 percent lithium, 4 percent copper, 0.4 percent silver, and 0.4 percent magnesium, with the remainder aluminum.

Lockhead Martin Space Systems Co. at NASA's Michoud Assembly Facility in New Orleans is the primary contractor for the External Tank. The Marshall Space Flight Center in Huntsville, AL., is NASA's lead center for development of space transportation and propulsion systems.