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SPACE SHUTTLE EXTERNAL TANK
STATISTICS AND COMPARISONS

The Space Shuttle is comprised of three major elements: the airplane-like Orbiter, its External Tank and twin Solid Rocket Boosters. The Space Shuttle's largest element, the External Tank (ET), is the structural backbone of the vehicle. Lockheed Martin Space Systems – Michoud Operations builds the ET at the NASA Michoud Assembly Facility in New Orleans. The ET provides liquid propellants to the Orbiter's three main engines, and during launch absorbs most of the seven million pounds of thrust exerted by the Solid Rocket Boosters and main engines.

The External Tank is 154 feet long, 27.6 feet in diameter and has a propellant capacity of 537,000 gallons (1.6 million pounds). Approximately 481,450 parts go into producing an ET -- and 38 miles of electrical wiring, 1,000 feet of insulated sleeving, 50 feet of coaxial cable, 4.7 miles of tape, 7,000 feet of safety wire and 4,000 pounds of thermal protection system materials. It requires more than one-half mile of welding to join together the aluminum panels that form the ET. The tank carries cryogenic propellants: liquid oxygen at minus 297 degrees Fahrenheit, and liquid hydrogen at minus 423 degrees Fahrenheit. These and other ET statistics may be more meaningful with the following comparisons.

Dimensions

At 154 feet long, the External Tank is slightly more than half the length of a football field. On his historic first flight, Orville Wright in 1903 kept his airplane aloft for a distance of 120 feet, 34 feet less than the length of the ET. The tank's diameter is 27.6 feet. Four men, each six feet tall, could stand on one another's shoulders inside a horizontal ET and the man on top still would not be able to touch the tank's opposite wall. The surface area of the ET is roughly equivalent to 1/3 acre.

Capacity

The External Tank's super cold propellants are fed to the Orbiter's engines at a rate of 1,035 gallons per second. That’s enough liquid every 18 seconds to fill a medium-sized backyard swimming pool. The tank carries enough liquid to fill 29 such swimming pools. It takes about 8½ minutes to empty the tank in flight.

Oxygen and hydrogen are liquefied prior to being loaded into the ET for use during the shuttle launch. If the propellants were not liquefied -- if the ET stored gaseous oxygen and hydrogen at ambient temperature and pressure -- the tank, at its current diameter of 27.6 feet, would need to be more than 16 miles tall.

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The liquid oxygen and liquid hydrogen tanks have a combined volume of 70,919 cubic feet, equivalent to five ranch-style three-bedroom homes.

Temperature

The coldest temperature ever recorded on Earth was minus 128.6 degrees Fahrenheit on July 21, 1983 in Antarctica. Absolute zero is defined as the temperature at which there is an absence of thermal energy. It doesn't get any colder. Absolute zero is minus 459.6 degrees Fahrenheit.

The liquid hydrogen in the shuttle's External Tank is maintained at minus 423 degrees Fahrenheit. The liquid oxygen is maintained at minus 297 degrees Fahrenheit.

The ET is covered by a polyurethane-like foam about one inch thick. The foam insulates the propellants to keep them from boiling off and keeps ice from forming on the tank's exterior. The tank's foam insulation also protects the tank's aluminum skin from the heat of aerodynamic friction during flight. In some areas, this temperature reaches 1,800 degrees Fahrenheit.

Strength and Weight

A new generation of Super Lightweight Tanks is now being produced. Vital to building and supplying the International Space Station, they weigh some 7,500 pounds less than previous External Tanks. Design changes and use of an aluminum-lithium alloy result in an overall weight of 58,500 pounds. The first Super Lightweight Tank made its initial flight on June 2, 1998, when it successfully powered Space Shuttle mission STS-91 into space.

The metal skin of the Super Lightweight Tank is less than one-half inch thick, yet it holds more than 1.6 million pounds of propellants and withstands the rigors of launch and flight while absorbing most of the seven million pounds of thrust loads.

The ratio of the tank's weight to the weight it carries is about 1:27. A standard pickup truck's weight-to-cargo ratio is 3:1.

If an aluminum soft drink can was expanded to the size of the ET, its walls would be about as thick as the tank's skin but it would not be nearly as strong.

Aluminum used in the tank, however, is not the same kind of aluminum used to make soft drink cans. The aluminum and steel alloys from which the tank is made contain some exotic sounding substances that contribute to the strength of the metal: manganese, titanium, columbium, tantalum and vanadium.

Lockheed Martin Space Systems – Michoud Operations builds the Space Shuttle External Tank, under contract to NASA's Marshall Space Flight Center.

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