Background

Shuttle Tiles


(Photo courtesy of NASA - www.nasaimages.org)

Img. 2 A close-up of the underside of the orbiter.

A key to a successful thermal protection system for the Space Shuttle depends on two things—light weight and the ability to withstand the high temperatures of reentry.

When the space shuttle de-orbits and begins to return to Earth, it faces a serious problem due to frictional heating. Protecting the shuttle and the crew from such heat is very important. When the shuttle reenters Earth's atmosphere at about 400,000 feet or about 122 km, it is traveling at about 25 times the speed of sound (Mach 25). It uses the friction of reentry to slow the shuttle down, but in doing so it pays a price in the form of frictional heating. Temperatures on the shuttle reach several thousand degrees. If the shuttle had a metal exterior like an airplane, it would be burn up due to the heat produced by the friction.

The tiles on the shuttle provide a means for thermal protection.

There are some 24,300 tiles that measure about six inches long on each side (15.25cm) and vary in thickness from 1 to 5 inches (2.54 to 12.7 cm) depending on where they are attached. They are made up of what is called a porous silicon material that is very light and extremely heat resistant. There are two main types of tiles, one a black-coated tile called HRSI for High-Temperature Reusable Surface Insulation tile. These tiles can withstand up to 2,300 degrees F (1,260 degrees C). They cover the bottom of the shuttle, areas around the forward windows, and several other key areas. The densities of these tiles range from 9-22 pounds per cubic foot.


(Photo courtesy of NASA - www.nasaimages.org)

The second type are white-coated tiles and are LowTemperature Reusable Surface Insulation (LRSI). They are made to insulate the shuttle up to 1,200 degrees F (650 degrees C). These tiles are usually larger and thinner, 8 inches long on each side (20.3cm) and from less than a half inch (1 cm) thick up to 1 inch (2.54 cm) in thickness. The densities range from 9 to 12 pounds per cubic foot.

The making of tiles begins with pure silica that comes from refined sand. This material is formed in fibers and mixed with pure water and other chemicals and then poured into a mold where the excess water is squeezed



A close-up of the tile numbering system.

out. This is then taken to the largest microwave oven in America located at the Lockheed Space Operations plant in Sunnyvale, California. After this they are treated in an oven at a temperature of 2,350 F (1,288 C). This process fuses the fibers without actually melting them.

The two types of tiles are essentially the same except for the coatings and cut. No two tiles are exactly alike. They fit by being trimmed to an exact size depending on its location on the shuttle. The tiles form the ultimate "jigsaw puzzle", only in this case, each piece is numbered so its location is easy to find.