

# 22 Years Ago at JSC

## Orbiter insulation tiles pass 100 re-entry heat chamber tests

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Materials which are planned for use as part of the space shuttle orbiter heat protection armor were recently subjected to the pressures and 2,300 degree heat of 100 re-entries with no damage, according to thermal specialists at JSC.

The shuttle orbiter, which is designed for reuse up to 100 times without major refurbishment, will have four separate light-weight, reusable heat-resistant materials affixed to the exterior of the 122-foot long space plane. The thermal protection system which will provide heat management as the vehicle speeds into orbit and returns to Earth, consists of coated reinforced carbon-carbon for nose cap and wing leading edges where temperatures exceed 2,300 degrees; high temperature reusable surface insulation for areas where maximum surface temperatures which reach 700-1,200 degrees and flexible reusable surface insulation, 3 by 4 sheets of Nomex fiber, for areas which will not exceed 700 degrees F.

The HRSI tests completed one week ago at JSC, began in early April, and were supplied by the Lockheed Missiles and Space Co., Sunnyvale, Calif., which has the responsibility for developing the orbiter thermal protection system. The test centered on the high temperature insulation materials which were coated with a new glass mixture developed by thermal specialists at Ames Research Center.

The insulation tiles were placed beneath a graphite heater in a test chamber in a thermal laboratory of JSC's Engineering and Development Directorate. Nine high temperature tiles

were used in the test.

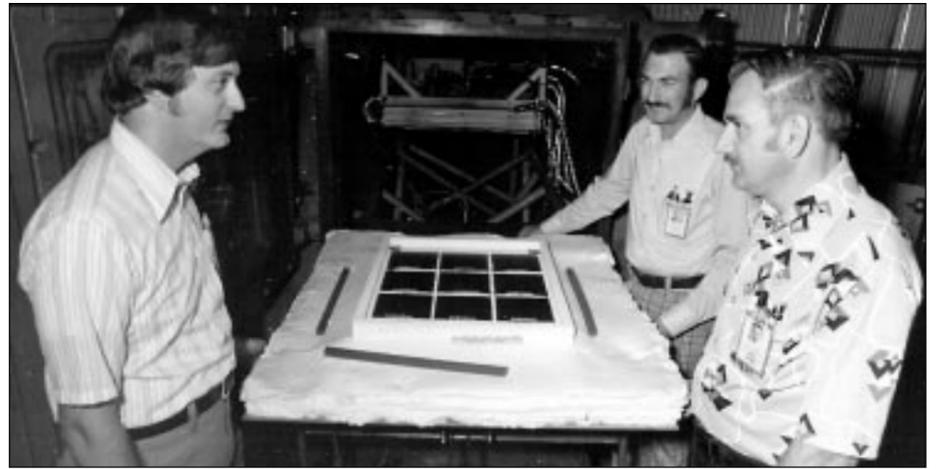
Each tile, nominally 6 by 6 inches, was sprayed with the glass mixture (silicon tetroboride additive with bora silicate glass) and then placed in the chamber and exposed to re-entry temperatures of 2,300 degrees F. Pressure inside the chamber also was regulated to duplicate the variable pressures the orbiter will undergo during the re-entry phase of the shuttle mission which begins at 400,000 feet altitude. The maximum re-entry heat is experienced when the orbiter reaches 200,000 feet altitude and is traveling at 12,000 miles per hour.

The test sequence, which lasted up to 30 minutes, was repeated during the month-long program to duplicate the 100 missions the orbiter will execute before refurbishment and maintenance of the thermal protection system will be necessary. This is the first time that the high temperature tiles have gone beyond 60 test cycles in NASA thermal test facilities without showing some signs of degradation.

At the end of the 100th test and after inspection of the tiles, Robert Dotts, subsystem manager of the reusable surface insulation system for JSC, said, "We now have a system (the tiles plus the new glass coating) which can fly 100 missions. We have a lot of confidence in the new development."

The high temperature tiles nominally vary in thickness from three-quarters of an inch to three inches. Approximately 25,000 of these tiles will be bonded to the orbiter's aluminum exterior. They will cover portions of the upper and lower fuselage, or about 5,000 square feet of the vehicle's surface.

The HRSI is made of a low density, high



NASA Photo S-76-24749

**NASA and Lockheed thermal engineers look over high temperature reusable insulation for the space shuttle orbiter which recently underwent heat and pressure tests simulating 100 re-entry cycles. The test was designed to test a new glass coating which was baked onto the reusable tiles. From left are Robert Stuckey, subsystem manager for the reusable insulation of the Structures and Mechanics Division; O.J. Clevinger, Northrop Services test engineer; and Donald J. Tillian, of the Thermal Protection Branch of the Structures and Mechanics Division. The nine test tiles are shown in front of the JSC test chamber.**

purity silica (glass) fiber with a silica binder. The new coating, reaction cured glass which is formed by mixing silicon tetroboride with borosilicate glass, is mixed with alcohol and sprayed on the tiles and then heated in an oven to a temperature of 2,200 degrees F. This results in a black waterproof glassy covering capable of withstanding the 2,300 degree heat of re-entry.

The reaction-cured glass was developed by an Ames research team headed by Howard Goldstein. This coating was introduced into the LMSC, Sunnyvale tile production facility in late 1975. LMSC fabricated the tiles and submitted them to JSC for the month-long test program.

More than 50 percent of the shuttle orbiter is covered with the low temperature reusable sur-

face insulation. Approximately 7,000 of these tiles, nominally 8 by 8 inches square, will be applied to the upper wing and side fuselage. They are the same material as the high temperature tile except for the differences in coating and optical pigment used to obtain solar absorptance and high emittance.

The reinforced carbon-carbon insulation covers those parts of the orbiter which will experience the highest heat load (in excess of 2,300 degrees F) and it covers about 500 square feet, along the nose and leading edge of the wings.

Altogether the insulation materials weigh approximately 20,000 lbs. The orbiter, which is 122 feet in length, weighs, without fuel and payload, 150,000 lbs. at liftoff.



**EVA Project Office Manager Greg Harbaugh presents the "Team EVA" trophy, a space suit helmet over a softball, to Glenn Lutz, coach of this year's Team EVA Softball Challenge champions from the Engineering Directorate's Crew and Thermal Systems Division.**

## Team EVA shares fun at Gilruth in extracurricular softball tourney

Pulling off successful space walks and making them look easy is not the only thing that the JSC EVA community is good at—a few of them know how to play softball, too.

Four teams representing the Mission Operations Directorate, EVA Project Office, the Safety, Reliability and Quality Assurance Office's Safety and Mission Assurance Division and Engineering's Crew and Thermal Systems Division got together on May 2 at the Gilruth Center and competed in the second annual Team EVA Softball Challenge.

The event, an idea from the EVA Project Office, grew by an additional team this year, with S&MA joining the mix. The tournament allows these close-knit groups to get together and have some fun with, and at the expense of each other, and is a great team building experience, said participant Glenn Lutz.

Competition for the traveling trophy was evident, but all the participants had plenty to laugh and talk about at the office the next week. Scores were kept and a champion was crowned but the real winner was the EVA community, which used the opportunity to further develop its team spirit as it prepares for the assembly and maintenance of the International Space Station.

This year's champions were from the Crew and Thermal Systems Division. The team was comprised of Joey Marmolejo, Joe Nowetner, Bill Lilly, Bruce Sauser, Joe Settles, Ketan "K.C." Chhipwadia, Craig Donnellan, Lee Willis, Jason Poffenberger, Steve Poulos, Mike Lawson, Matt Davis, Hiep Nguyen, Michael Nguyen, David Hower, and Coach Glenn Lutz.

Members of the S&MA team, which placed fourth, playing under the

managerial skills of Hayden Krueger were Scott Stevens, Chuck Franca, Katie Allen, Elizabeth and Steve Conner, David and Kelly Rodrigues, Rod Toler, Cuong Nguyen, and Amie Tavanese.

The MOD team included Coach Paul Boehm, Terry Neal, Kerri Knotts, Gary Flynt, Anna Jarvis, Sean Dougherty, Arne Aamodt, Ed Tom, Phillip Fox, Scott Bleisath, Colin Anglin, Alan Groskreutz, Daryl Hemmingway, and Michelle Hollinger.

The EVA Project Office, last year's champs, placed second this year, represented by Coach Al Morey, Dave Adlis, Irene Bibyk, Larry Gana, George Gurgis, Greg Harbaugh, Robbie LaBrier, Mike Mankin, Greg Smith, Robert Yowell and John Russo.

All of the teams offered thanks to Calvin Schomburg and Sean Clardy who umpired the games at the Gilruth Center.

## Gilruth Center News

**Nutrition intervention program:** Six-week program includes lectures, a private consultation with the dietitian and blood analysis to chart your progress. For more information call Tammie at x32980.

**Defensive driving:** One-day course is offered once a month at the Gilruth Center. Pre-registration required. Cost is \$25. Call for next available class.

**Stamp club:** Meets at 7 p.m. every second and fourth Monday in Rm. 216.

**Weight safety:** Required course for employees wishing to use the Gilruth weight room. The next classes are scheduled for at 8 p.m. May 28 (must be on time to receive credit for class). Pre-registration is required. Cost is \$5. Annual weight room use fee is \$90. Additional family members are \$50.

**Exercise:** Low-impact class meets from 5:15-6:15 p.m. Mondays and Wednesdays. Cost is \$24 for eight weeks.

**Aikido:** Introductory martial arts class meets from 5:15-6:15 p.m. Tuesday and Wednesday. New classes begin the first of each month. Instruction is by a fourth-degree black belt. Learn to defend yourself and get a great aerobic workout. Cost is \$35 per month.

**Step/bench aerobics:** Low impact cardiovascular workout. Classes meet from 5:15-6:15 p.m. Monday, Tuesdays and Thursdays. Cost is \$32 for eight weeks. For more information, call Kristen at x36891.

**Yoga:** Stretching Class. Low impact exercises expertly designed for people of all ages and abilities in a Westernized format 5-6 p.m. Thursdays. Cost is \$32 for eight weeks.

**Ballroom dancing:** Beginning and advanced students meet from 7-10 p.m. Thursdays. Cost is \$60 per couple.

**Country and western dancing:** Beginner class meets 7-8:30 p.m. Monday. Advanced class (must know basic steps to all dances) meets 8:30-10 p.m. Monday. Cost is \$20 per couple.

## Ticket Window

Bldg. 3 Exchange Store hours are 7 a.m.-4 p.m. Monday-Friday.  
Bldg. 11 Exchange Store hours are 9 a.m.-3 p.m. Monday-Friday.  
For more information, please call x35350.

The following discount tickets are available at the Exchange Stores:

General Cinema Theaters	.....	\$ 5.50
Sony Loew's Theaters	.....	\$ 5.00
AMC Theaters	.....	\$ 4.75
Astroworld Early Bird Tickets (valid thru 5/31)	.....	\$18.50
Astroworld One Day Admission	.....	\$24.25
(valid at all Texas Six Flags Theme Parks)		
Astroworld Season Pass	.....	\$57.75
(valid at all Texas Six Flags Theme Parks and Water World)		
Moody Gardens (2 of 6 events)	.....	\$ 9.75
Sea World	.....adult \$27.25 ... child (3-11)	\$18.25
Schilferrbahn	.....adult \$20.75 ... child (3-11)	\$17.50
Space Center Houston	.....adult \$10.25 ... child (4-11)	\$ 7.00

Metro Tokens and value cards available.

**Coming Soon:** Splashtown Water Park and Houston Comets Tickets.