NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE
MISSION
STS-28

PRESS KIT
AUGUST 1989

DEPARTMENT OF DEFENSE MISSION

STS-28 INSIGNIA

S88-40309 **--** *The insignia was designed by the crew, who said it portrays the pride the American people have in their manned spaceflight program. It depicts America (the eagle) guiding the space program (the space shuttle) safely home from an orbital mission. The view looks south on Baja California and the west coast of the United States as the space travelers reenter the atmosphere. The hypersonic contrails created by the eagle and shuttle represent the American flag. The crew called the simple boldness of the design symbolic of American's unfaltering commitment to leadership in the exploration and development of space.*

The NASA insignia design for space shuttle flights is reserved for use by the astronauts and for other official use as the NASA Administrator may authorize. Public availability has been approved only in the form of illustrations by the various news media. When and if there is any change in this policy, which we do not anticipate, it will be publicly announced.

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

STS-28 CREWMEMBERS

S89-29369 – This is the official crew portrait for the STS-28 Department of Defense mission, with the crewmembers in their military uniforms. Seated are (l. to r.) pilot Richard N. Richards; mission commander Brewster H. Shaw and mission specialist David C. Leestma. In the back row are mission specialists Mark N. Brown and James C. Adamson. The U.S. flag and mission insignia are in the background.

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STS-28

PRESS INFORMATION

August 1989

Rockwell International

Space Transportation
Systems Division

Office of Media Relations

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FOREWORD

STS-28 is the eighth flight of Columbia and the 30th in the space transportation system program. This flight is a dedicated DOD mission.

The flight crew for the STS-28 mission consists of the following:

Commander: Brewster H. Shaw (third flight)
Pilot: Richard N. Richards (first flight)
Mission specialist: David C. Leestma (second flight)
Mission specialist: James C. Adamson (first flight)
Mission specialist: Mark N. Brown (first flight)

On the cover is the STS-28 flight crew portrait. Seated, from left to right, are Dick Richards, Brewster Shaw and David Leestma. Standing, from left to right, are Mark Brown and Jim Adamson.

Prelaunch commentary for this mission begins at T minus 9 minutes and concludes at main engine cutoff (MECO).

The date and time of landing at Edwards Air Force Base, Calif., will be announced 24 hours before touchdown.

COLUMBIA MODIFICATIONS

Upon the completion of Columbia's sixth flight, it was returned to Rockwell International's Palmdale, Calif., assembly facility for structural modifications on January 30, 1984.

There were approximately 216 modifications accomplished at Palmdale and an additional 45 modifications accomplished after its return to the Kennedy Space Center, Fla., on July 14, 1985.

Major modifications accomplished at Palmdale included the removal of the flight deck commander and pilot ejection seats and overhead ejection panels; reconfiguration of the flight deck seating to that of the operational configuration; strengthening of the wing, midbody, and aft sections; installation of the heads-up displays to the flight deck; and upgrading of the various systems and components aboard Columbia.

Additional modifications included work on the thermal protection system and propulsion systems, installation of wiring and loads instrumentation, rewiring of the crew module to the operational configuration, and orbiter experiments installation.

The OEX installations were the Shuttle Infrared Leeside Thermal Sensing on the vertical tail, Shuttle Entry Air Data System on the reinforced carbon-carbon nose cap, the Shuttle Upper-Atmosphere Mass Spectrometer at the forward fuselage forward bulkhead nose wheel well location, OEX recorder and interface control module in the crew module, and the aerodynamic coefficient identification package/high resolution accelerometer package in the mid fuselage.

The major modifications accomplished at the Kennedy Space Center included upgrading the nose wheel steering system, additional wing structural modifications, and upgraded auxiliary power units and controllers.

Columbia then flew its seventh mission, STS 61-C, January 12-18, 1986.

Prior to its return to flight in the STS-28 mission, improvements and modifications were made to Columbia's systems and components similar to those made on Discovery and Atlantis prior to their returns to flight.

One visible difference of Columbia from Discovery and Atlantis is the SILTS pod on the vertical tail of Columbia. SILTS consists of a cylindrical housing approximately 20 inches in diameter that is capped at the leading edge by a spherical dome. Mounted inside the dome is an infrared camera that obtains images of the upper (leeside) surfaces of Columbia's port (left) wing and fuselage during entry. The images provide detailed temperature maps at the surface of the leeside thermal protection materials and indicate the degree of aerodynamic heating of the surface in flight. SILTS is activated by Columbia's computer at about 400,000 feet and terminates after passing through the period of significant aerodynamic heating. This experiment, along with others, operated successfully in the STS 61-C flight of Columbia.

Another visible difference of Columbia in its return to flight from its STS 61-C flight is the removal of the majority of the low-temperature reusable insulation thermal protection system (white) tiles. The LRSI tiles were replaced with the advanced flexible reusable surface insulation blankets, similar to those of Discovery and Atlantis. In addition, the painting of Columbia's name on the orbiter is now in the same location as Discovery and Atlantis. Previously Columbia's name was painted on its payload bay doors.

The following identifies the major improvements and modifications made to Columbia for the STS-28 return-to-flight mission. Approximately 190 other modifications and improvements were made to Columbia.

ORBITAL MANEUVERING SYSTEM/REACTION CONTROL SYSTEM AC-MOTOR-OPERATED VALVES. The 64 valves operated by ac motors in the OMS and RCS were modified to incorporate a "sniff" line for each valve to permit monitoring of nitrogen tetroxide or monomethyl hydrazine in the electrical portion of the valves during ground operations. This new line reduces the probability of floating particles in the electrical microswitch portion of each valve, which could affect the operation of the microswitch position indicators for onboard displays and telemetry. It also reduces the probability of nitrogen tetroxide or monomethyl hydrazine leakage into the bellows of each ac-motor-operated valve.

PRIMARY RCS THRUSTERS. The wiring of the fuel and oxidizer injector solenoid valves was wrapped around each of the 38 primary RCS thrust chambers to remove electrical power from these valves in the event of a primary RCS thruster instability.

FUEL CELL POWER PLANTS. End-cell heaters on each fuel cell power plant were deleted because of potential electrical failures and replaced with Freon coolant loop passages to maintain uniform temperature throughout the power plants. In addition, the hydrogen pump and water separator of each fuel cell power plant were improved to minimize excessive hydrogen gas entrained in the power plant product water. A current measurement detector was added to monitor the hydrogen pump of each fuel cell power plant and provide an early indication of hydrogen pump overload.

The starting and sustaining heater system for each fuel cell power plant was modified to prevent overheating and loss of heater elements. A stack inlet temperature measurement was added to each fuel cell power plant for full visibility of thermal conditions.

The product water from all three fuel cell power plants flows to a single water relief control panel. The water can be directed from the single panel to the environmental control and life support system's potable water tank A or to the fuel cell power plant water relief nozzle. Normally, the water is directed to water tank A. In the event of a line rupture in the vicinity of the single water relief panel, water could spray on all three water relief panel lines, causing them to freeze and preventing water discharge.

The product water lines from all three fuel cell power plants were modified to incorporate a parallel (redundant) path of product water to ECLSS potable water tank B in the event of a freeze-up in the single water relief panel. If the single water relief panel freezes up, pressure would build up and discharge through the redundant paths to water tank B.

A water purity sensor (pH) was added at the common product water outlet of the water relief panel to provide a redundant measurement of water purity (a single measurement of water purity in each fuel cell power plant was provided previously). If the fuel cell power plant pH sensor failed in the past, the flight crew had to sample the potable water.

AUXILIARY POWER UNITS. The APUs that have been in use to date have a limited life. Each unit was refurbished after 25 hours of operation because of cracks in the turbine housing, degradation of the gas generator catalyst (which varied up to approximately 30 hours of operation) and operation of the gas generator valve module (which also varied up to approximately 30 hours of operation). The remaining parts of the APU were qualified for 40 hours of operation.

A new turbine housing increases the life of the housing to 75 hours of operation (50 missions); a new gas generator increases its life to 75 hours; a new standoff design of the gas generator valve module and fuel pump deletes the requirement for a water spray system that was required previously for each APU upon shutdown after the first OMS thrusting period or orbital checkout; and the addition of a third seal in the middle of the two existing seals for the shaft of the fuel pump/lube oil system (previously only two seals were located on the shaft, one on the fuel pump side and one on the gearbox lube oil side) reduces the probability of hydrazine leaking into the lube oil system.

The deletion of the water spray system for the gas generator valve module and fuel pump for each APU results in a weight reduction of approximately 150 pounds for each orbiter. Upon the delivery of the improved units, the life-limited APUs will be refurbished to the upgraded design.

In the event that a fuel tank valve switch in an auxiliary power unit is inadvertently left on or an electrical short occurs within the valve electrical coil, additional protection is provided to prevent overheating of the fuel isolation valves.

MAIN LANDING GEAR. The following modifications were made to improve the performance of the main landing gear elements:

1. The thickness of the main landing gear axle was increased to provide a stiffer configuration that reduces brake-to-axle deflections and precludes brake damage experienced in previous landings. The thicker axle should also minimize tire wear.
2. Orifices were added to hydraulic passages in the brake's piston housing to prevent pressure surges and brake damage caused by a wobble/pump effect.
3. The electronic brake control boxes were modified to balance hydraulic pressure between adjacent brakes and equalize energy applications. The anti-skid circuitry previously used to reduce brake pressure to the opposite wheel if a flat tire was detected has now been removed.
4. The carbon-lined beryllium stator discs in each main landing gear brake were replaced with thicker discs to increase braking energy significantly.
5. A long-term structural carbon brake program is in progress to replace the carbon-lined beryllium stator discs with a carbon configuration that provides higher braking capacity by increasing maximum energy absorption.
6. Strain gauges were added to each nose and main landing gear wheel to monitor tire pressure before launch, deorbit and landing.
7. The improvements made in items 1 through 6 on Discovery and Atlantis have allowed the brakes on these vehicles to be reflown.

NOSE WHEEL STEERING. The nose wheel steering system was modified on Columbia (OV-102) for the 61-C mission. This modification allows a safe high-speed engagement of the nose wheel steering system and provides positive lateral directional control of the orbiter during rollout in the presence of high crosswinds and blown tires.

THERMAL PROTECTION SYSTEM. The area aft of the reinforced carbon-carbon nose cap to the nose landing gear doors has sustained damage (tile slumping) during flight operations from impact during ascent and overheating during re-entry. This area, which previously was covered with high-temperature reusable surface insulation tiles, will now be covered with reinforced carbon-carbon.

Because of evidence of plasma flow on the lower wing trailing edge and elevon landing edge tiles (wing/elevon cove) at the outboard elevon tip and inboard elevon, the low-temperature tiles are being replaced with fibrous refractory composite insulation (FRCI-12) and high-temperature (HRSI-22) tiles along with gap fillers on Discovery and Atlantis. On Columbia only gap fillers are installed in this area.

GENERAL-PURPOSE COMPUTERS. New, upgraded general-purpose computers (AP-101S) will replace the existing GPCs aboard the space shuttle orbiters in the early 1990s. The upgraded computers allow NASA to incorporate more capabilities into the orbiters and apply advanced computer technologies that were not available when the orbiter was first designed. The new computer design began in January 1984, whereas the older design began in January 1972. The upgraded GPCs provide 2.5 times the existing memory capacity and up to three times the existing processor speed with minimum impact on flight software. They are half the size, weigh approximately half as much, and require less power to operate.

INERTIAL MEASUREMENT UNITS. The new high-accuracy inertial navigation system will be phased in to augment the present KT-70 inertial measurement units in the early 1990s. These new IMUs will result in lower program costs over the next decade, ongoing production support, improved performance, lower failure rates and reduced size and weight. The HAINS IMUs also contain an internal dedicated microprocessor with memory for processing and storing compensation and scale factor data from the vendor's calibration, thereby reducing the need for extensive initial load data for the orbiter's computers. The HAINS is both physically and functionally interchangeable with the KT-70 IMU.

CREW ESCAPE SYSTEM. The in-flight crew escape system is provided for use only when the orbiter is in controlled gliding flight and unable to reach a runway. This would normally lead to ditching. The crew escape system provides the flight crew with an alternative to water ditching or to landing on terrain other than a landing site. The probability of the flight crew surviving a ditching is very small.

The hardware changes required to the orbiters would enable the flight crew to equalize the pressurized crew compartment with the outside pressure via a depressurization valve opened by pyrotechnics in the crew compartment aft bulkhead that would be manually activated by a flight crew member in the middeck of the crew compartment; pyrotechnically jettison the crew ingress/egress side hatch in the middeck of the crew compartment; and bail out from the middeck of the orbiter through the ingress/egress side hatch opening after manually deploying the escape pole through, outside and down from the side hatch opening. One by one, each crew member attaches a lanyard hook assembly, which surrounds the deployed escape pole, to his or her parachute harness and egresses through the side hatch opening. Attached to the escape pole, the crew member slides down the pole and off the end. The escape pole provides a trajectory that takes the crew members below the orbiter's left wing.

Changes were also made in the software of the orbiter's general-purpose computers. The software changes were required for the primary avionics software system and the backup flight system for transatlantic-landing and glide-return-to-launch-site aborts. The changes provide the orbiter with an automatic-mode input by the flight crew through keyboards on the commander's and/or pilot's panel C3, which provides the orbiter with an automatic stable flight for crew bailout.

EMERGENCY EGRESS SLIDE. The emergency egress slide provides orbiter flight crew members with a means for rapid and safe exit through the orbiter middeck ingress/egress side hatch after a normal opening of the side hatch or after jettisoning the side hatch at the nominal end-of-mission landing site or at a remote or emergency landing site.

The emergency egress slide replaces the emergency egress side hatch bar, which required the flight crew members to drop approximately 10.5 feet to the ground. The previous arrangement could have injured crew members or prevented an already-injured crew member from evacuating and moving a safe distance from the orbiter.

17-INCH ORBITER/EXTERNAL TANK DISCONNECTS. Each mated pair of 17-inch disconnects contains two flapper valves: one on the orbiter side and one on the external tank side. Both valves in each disconnect pair are opened to permit propellant flow between the orbiter and the external tank. Prior to separation from the external tank, both valves in each mated pair of disconnects are commanded closed by pneumatic (helium) pressure from the main propulsion system. The closure of both valves in each disconnect pair prevents propellant discharge from the external tank or orbiter at external tank separation. Valve closure on the orbiter side of each disconnect also prevents contamination of the orbiter main propulsion system during landing and ground operations.

Inadvertent closure of either valve in a 17-inch disconnect during main engine thrusting would stop propellant flow from the external tank to all three main engines. Catastrophic failure of the main engines and external tank feed lines would result.

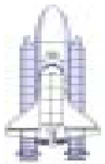
To prevent inadvertent closure of the 17-inch disconnect valves during the space shuttle main engine thrusting period, a latch mechanism was added in each orbiter half of the disconnect. The latch mechanism provides a mechanical backup to the normal fluid-induced-open forces. The latch is mounted on a shaft in the flowstream so that it overlaps both flappers and obstructs closure for any reason.

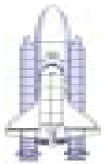
In preparation for external tank separation, both valves in each 17-inch disconnect are commanded closed. Pneumatic pressure from the main propulsion system causes the latch actuator to rotate the shaft in each orbiter 17-inch disconnect 90 degrees, thus freeing the flapper valves to close as required for external tank separation.

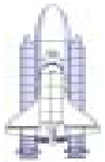
A backup mechanical separation capability is provided in case a latch pneumatic actuator malfunctions. When the orbiter umbilical initially moves away from the external tank umbilical, the mechanical latch disengages from the external tank flapper valve and permits the orbiter disconnect flapper to toggle the latch. This action permits both flappers to close.

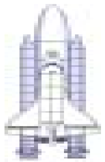
SHUTTLE FLIGHTS AS OF AUGUST 1989

29 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 4 SINCE RETURN TO FLIGHT









	STS-51L 01/28/86		
	STS-61A 10/30/85 - 11/06/85		
	STS-51F 07/29/85 - 08/06/85	STS-29 03/13/89 - 03/18/89	
STS-61C 01/12/86 - 01/18/86	STS-51B 04/29/85 - 05/06/85	STS-26 09/29/88 - 10/03/88	
STS-9 11/28/83 - 12/08/83	STS-41G 10/05/84 - 10/13/84	STS-51-I 08/27/85 - 09/03/85	
STS-5 11/11/82 - 11/16/82	STS-41C 04/06/84 - 04/13/84	STS-51G 06/17/85 - 06/24/85	
STS-4 06/27/82 - 07/04/82	STS-41B 02/03/84 - 02/11/84	STS-51D 04/12/85 - 04/19/85	STS-30 05/04/89 - 05/08/89
STS-3 03/22/82 - 03/30/82	STS-8 08/30/83 - 09/05/83	STS-51C 01/24/85 - 01/27/85	STS-27 12/02/88 - 12/06/88
STS-2 11/12/81 - 11/14/81	STS-7 06/18/83 - 06/24/83	STS-51A 11/08/84 - 11/16/84	STS-61B 11/26/85 - 12/03/85
STS-1 04/12/81 - 04/14/81	STS-6 04/04/83 - 04/09/83	STS-41D 08/30/84 - 09/05/84	STS-51J 10/03/85 - 10/07/85
OV-102 **Columbia** **(7 flights)**	**OV-099** **Challenger** **(10 flights)**	**OV-103** **Discovery** **(8 flights)**	**OV-104** **Atlantis** **(4 flights)**