National Aeronautics and
Space Administration

Space Shuttle *Discovery* Returns from Space

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After eleven days in space, *Discovery* mission STS-105 returns to Earth. Discovery is one of NASA's three reusable launch vehicles used to carry payloads and crewmembers into space.

When a mission's planned in-orbit operations have been accomplished, the emphasis onboard the orbiter turns to the task of preparing the vehicle for its return to Earth. The crew typically spends the day before entry stowing equipment, cleaning up the living areas, and making final system tests which ensure a safe entry and landing.

On the day of entry, the crew usually wakes up six hours before the deorbit burn and performs the final system tests needed for entry. The spacecraft maneuvers into a tail-first attitude before performing the deorbit burn. The orbital maneuvering system (OMS) engines fire to slow the spacecraft, which lowers it into the atmosphere. The orbiter then turns back into a nose-first attitude before it encounters the atmosphere. As atmospheric pressure builds up, the orbiter switches from spacecraft-like operation to aircraft operations. During descent, the vehicle's thrusters are gradually switched off and replaced by aerodynamic control surfaces in response to the building atmospheric pressure. The atmosphere causes drag, which slows the spacecraft down from orbital velocity to a safe landing speed.

The orbiter's exterior heats up to as much as 1,620° C shortly after entering the atmosphere, due to friction caused by drag.

Extensive thermal protection shields the spacecraft from the high heat levels. Gray-colored composite material protects the areas (the nose and leading edge of the wings) from the most intense heat. Most black tiles, which cover the belly and portions along the side of the orbiter, heat up to as much as 816° C. White tiles and thermal blankets protect the rest of the spacecraft, where temperatures are lower.

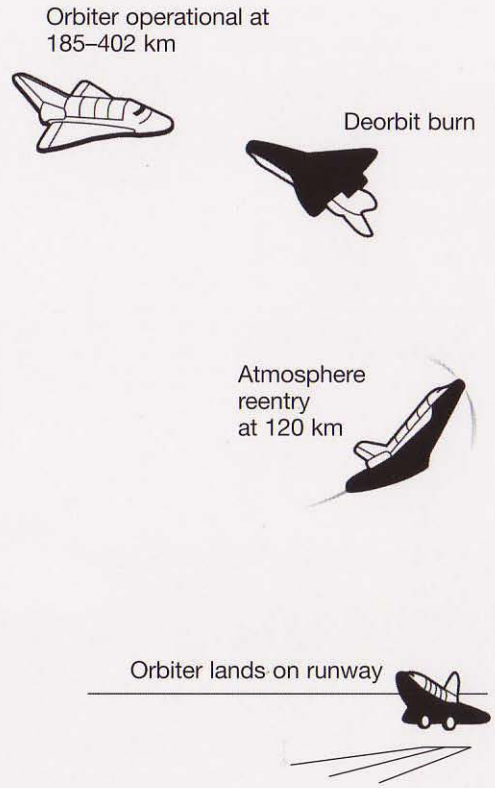
The onboard computers fly the orbiter until it goes subsonic (slower than the speed of sound or Mach 1) approximately four minutes prior to landing. At this time, the commander takes manual flight control of the spacecraft and flies a large spiral approach centered about 13 km from the runway threshold. At the completion of the spiral approach, the orbiter lines up with the runway centerline at an altitude of about 3 km and 11 km downrange from the runway threshold.

Once lined up with the runway, the orbiter flies a steep 18° to 20° flight path until an altitude of about 600 m when it begins shallowing out to a 1.5° flight path. The pilot lowers the landing gear at an altitude of 100 m, and the commander lands the orbiter about 750 m past the runway threshold. Shortly after landing, the pilot deploys the drag chute, and the commander lowers the nose and applies wheel brakes. After about one hour of post-landing activities, which include shutting down systems, the crew exits the orbiter marking the completion of another successful Space Shuttle mission.

Facts and Figures (Typical Mission)

Maximum Mach number	Mach 26
Orbital velocity	27,500 km/hr
Atmosphere reentry velocity	28,500 km/hr
Average descent rate	70 m/sec
Maximum descent rate	150 m/sec
Maximum G force	1.6 g's
Maximum airspeed at touchdown	575 km/hr
Landing velocity	370 km/hr
Landing weight	82,000–102,000 kg
Runway length	4.6 km
Rollout distance	3 km

Space Shuttle Orbit to Landing Profile



Electronic Resources

Additional information is available on the World Wide Web at the following address: *http://spaceflight.nasa.gov*

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