NASA Fact Sheet

National Aeronautics and
Space Administration

Marshall Space Flight Center
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The Inertial Upper Stage (IUS)

The Inertial Upper Stage (IUS) is a two-stage, solid rocket propelled, three-axis stabilized vehicle for placing spacecraft in a high-Earth orbit or on an escape trajectory for an interplanetary mission. In some of its recent applications, it has boosted NASA's Tracking and Data Relay Satellites (TDRS) from low-Earth orbit to geosynchronous altitude and helped send the Galileo probe on a journey to explore Jupiter, the Magellan spacecraft to Venus, and the Ulysses toward a polar orbit of the Sun.

Backgound

The IUS was originally designed as a temporary stand-in for a reusable space tug. The IUS was then named the Interim Upper Stage. The word "Inertial" (signifying the guidance technique) later replaced "Interim" when it was seen that the IUS would be needed through the 1990's.

The IUS was developed and built by the Boeing Aerospace Co., Seattle, Wash. under contract to the Air Force Material Command's Space and Missile Systems Center. The Space and Missile Systems Center is executive agent for all Department of Defense activities pertaining to the Space Shuttle system and provides the IUS to NASA for Space Shuttle use. For NASA missions, the IUS program is managed by the Marshall Space Flight Center in Huntsville, Ala.

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NASA's most recent use of an IUS was on the STS-70 mission of the Space Shuttle (launched July 13, 1995), which successfully transported the TDRS-G satellite to geosynchronous orbit, some 22,300 statute miles (35,880 kilometers) from Earth.

Specifications

The IUS is 17 feet (5.18 meters) long and 9.25 feet (2.8 meters) in diameter, with an overall weight of approximately 32,500 pounds (14,742 kilograms). The IUS consists of a first stage comprised of a solid rocket motor (SRM1) containing 21,400 pounds (9,707 kilograms) of propellant and generating approximately 42,000 pounds (188,496 newtons) of thrust and an interstage. The second stage consists of a solid rocket motor (SRM2) with 6,000 pounds (2,722 kilograms) of propellant generating approximately 18,000 pounds (80,784 newtons) of thrust, and an equipment support section.

The large SRM1 motor is the longest thrusting duration solid rocket motor ever developed for space application, with the capability to thrust as long as 150 seconds. Mission requirements determine the thrust level and burn duration of the SRM1 which are controlled by tailoring the solid propellant load.

The equipment support section houses the avionics systems of the IUS. These systems provide guidance, navigation, control, telemetry, command and data management, reaction control and electrical power. All mission-critical components of the avionics system, along with thrust vector actuators, reaction control thrusters, motor igniter and pyrotechnic stage separation equipment are redundant to assure reliability of better than 98 percent.

The IUS employs Airborne Support Equipment (ASE) for installation in the Space Shuttle as well as operation and deployment from the Space Shuttle. The IUS ASE consists of the mechanical, avionics, and structural equipment located in the orbiter. The ASE structurally attaches the IUS and the payload to the orbiter payload bay, provides interface for the IUS and payload checkout and elevates the IUS/payload for deployment from the orbiter.