

Hubble Facts

National Aeronautics and
Space Administration

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Hubble Space Telescope Servicing Mission 3A CREW AIDS AND TOOLS

Servicing Hubble in Orbit

While other spacecraft have been retrieved or repaired by astronauts, the Hubble Space Telescope (HST) is the first designed with replaceable parts and instruments for planned servicing. To enable astronauts to change out parts and instruments, Hubble was built with 225 feet of handrails and 31 foot restraint sockets to give the astronauts safe, convenient worksites as they orbit Earth at 17,000 mph.

During the Fall 1999 mission, the seven-member crew of STS-103 will rendezvous with the Telescope, capture it with the Space Shuttle Discovery's robotic arm and dock it in the Shuttle bay. Working in teams of two, the four spacewalking astronauts will outfit Hubble with new

equipment, including six gyroscopes, a Fine Guidance Sensor, Solid State Recorder, new Main Computer, and a transmitter.

The astronauts will take more than 150 crew aids and tools on this service call. These range from a simple bag to sophisticated, computer-operated power tools. Some are standard items from the Shuttle's toolbox; others are unique to this mission. All are designed to accommodate and compensate for the astronauts' bulky, pressurized gloves and space suits.

Crew Aids

Crew aids are fixed-in-place or portable equipment items, other than hand tools, that assist astronauts in accomplishing their tasks. Crew aids permit the astronauts to maneuver safely or to anchor themselves while working in the weightlessness of space. Examples of crew aids are: handrails, handholds, transfer equipment, protective covers, tethering devices, foot restraint platforms, tool caddies, and stowage and parking fixtures. An example of a restraint is the Portable Foot Restraint. An astronaut places both feet in this restraint, holding him in place while he performs a task. The Translation Aid is a long, adjustable-length arm that the astronaut uses when moving between the payload bay and the Telescope.

Astronauts servicing Hubble use two different kinds of foot restraints to counteract their weightless environment. When anchored in a



Astronaut Mark Lee using handholds to maneuver around Telescope.

Manipulator Foot Restraint, an astronaut can be transported from one worksite to the next with the robotic arm. With the Portable Foot Restraint, a stable platform is established by mounting the restraint to any of the strategically placed receptacles on the Telescope.

Portable handles are attached to many larger pieces of replaceable equipment to aid in removal or installation.

Tools

Tools are hand-operated devices that allow space-walking astronauts to efficiently perform intricate, labor-intensive tasks. Some tools are used on each servicing mission for loosening and tightening bolts. Others are specially designed for specific tasks. For example, a tool called a fastener capture tool, will efficiently remove and hold the bolts removed from the transmitter.

Engineers anticipate that the aft shroud doors' latch mechanisms may have seized due to many years of extreme temperature fluctuations. To prepare for this, engineers developed special tools and replacement latches.

Power Tools

The astronauts' main power tools are the Power Ratchet Tool and the Pistol Grip Tool. Astronauts used the Power Ratchet Tool, a power tool specifically developed for Hubble's first servicing mission in 1993. The experiences and recommendations gained from this mission led to the development of the smaller, more efficient Pistol Grip Tool. This newer tool has been used successfully on several missions for the Hubble Space Telescope and the International Space Station. Because of their different capabilities and limitations, both tools are used to service Hubble.

The Power Ratchet Tool is a 3/8" right angle drive power tool used for tasks requiring controlled torque, speed or turns. It consists of a wrench, controller, umbilical and battery module. It is capable of 0.5 to 25 foot-pounds (*an average man or woman usually exerts about 2 to 5 foot-pounds of torque by hand with a regular screw-driver*) of motorized torque and 75 foot-pounds of manual torque. The Power Ratchet Tool weighs 8 pounds and is powered by a 28-volt silver zinc battery.

The Pistol Grip Tool is a self-contained, computer-controlled, battery-powered 3/8 inch drive power tool with a pistol-style handle. Numerous torque, speed and turn limits can be programmed into the tool for mission-specific applications. A light emitting diode display on the tool tells the astronaut what torque he or she is applying, at what speed, and how many turns the motor has made. It also displays error messages. The motorized torque ranges from 2 to 25 foot-pounds, the speed from 5 to 60 rotations per minute, and the number of turns from 0 to 999. In manual mode, the Pistol Grip Tool can apply 38 foot-pounds of torque.

The Hubble crew aids and tools have proven in previous servicing missions that they are key components in achieving safe, efficient tasks by the space-walking astronauts.

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