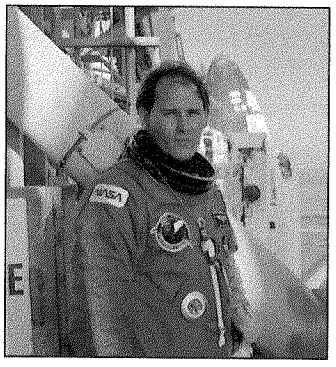
NASAfacts

Sonny Carter Training Facility:
The Neutral Buoyancy Laboratory



The Neutral Buoyancy Laboratory (NBL) was named after Astronaut Manley L. "Sonny" Carter, Jr. He was a physician, aviator and NASA astronaut who died in a civil aviation accident at age 43.

The mission of the NBL is to prepare for space missions involving spacewalks. NASA team members use the NBL to develop flight procedures, verify hardware compatibility, train astronauts and refine spacewalk procedures during flight that are necessary to ensure mission success.

The ability to perform on-orbit assembly and maintenance operations successfully and predictably is critical to future space endeavors. The International Space Station will require hundreds of hours of spacewalks for assembly. The phenomenal scientific discoveries of the Hubble Space Telescope are a result of successful maintenance spacewalks. Clearly, spacewalks are the cornerstone for current and future space initiatives and the NBL is the foundation for successful spacewalk preparation.

Neutral Buoyancy

What is neutral buoyancy, and how does it resemble zero gravity (weightlessness)? Neutral buoyancy is the equal tendency of an object to sink or float. If an item is made neutrally buoyant through a combination of weights and flotation devices, it will seem to "hover" under water. In such a state, even a heavy object can be easily manipulated, much as it is in the zero gravity of space. However, there are two important differences between neutral buoyancy as achieved in the NBL and weightlessness. The first is that suited astronauts training in the NBL are not truly weightless. While they are neutrally buoyant, they nonetheless feel their weight while in their suits. The second is that water drag hinders motion, making some tasks easier, and others more difficult, to perform in the NBL than in zero gravity. These differences must be recognized by spacewalk trainers. However, despite these differences, neutral buoyancy is currently the best method available by which astronauts train for spacewalks.

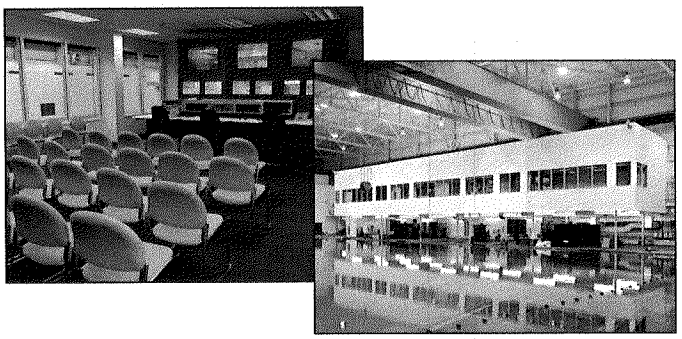
NBL Size

The NBL was sized to perform two activities simultaneously; each uses mockups sufficiently large to produce meaningful training content and duration. It is 202 ft in length, 102 ft in width and 40 ft in depth

(20 ft above ground level and 20 ft below) and holds 6.2 million gallons of water. Even at this size, the International Space Station, at 350 ft x 240 ft when complete, will not fit inside the NBL.

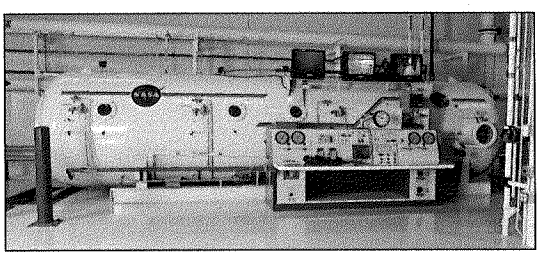
Simulation Control

The NBL simulation control areas provide resources for all disciplines involved in the execution of spacewalk training sessions: facility operations, safety, communications, video support, medicine, suit technicians, support divers, crew training and technical observers.



Medical Treatment Systems

A medical team is present to monitor the condition of all dive personnel. A fully configured hyperbaric chamber is available should emergency decompression sickness treatment be necessary.



Mockup Assembly and Handling

The NBL is replete with systems and personnel to design, manufacture, assemble, test, maintain, reposition and store neutral buoyancy mockups. Two overhead bridge cranes (each capable of lifting 10 tons) and four jib cranes (each capable of lifting 1.6 tons) around the perimeter of the NBL are used to configure mockups for each training session. The jib cranes also lower and lift the suited astronauts into and out of the water.

Communication Systems

A full complement of voice communication systems is available. This includes full two-way communications among the suited astronauts, topside trainers, facility test coordinators, the flight control team within JSC's Mission Control Center and the remainder of the shuttle crew (not performing spacewalks) at the onsite Shuttle Mission Simulator. One-way communication to the scuba divers is available via an underwater radio frequency system or a series of underwater speakers.

Remote Manipulator Systems

Full-scale working models of the shuttle and station robotic arms are critical NBL components. Both models are hydraulically operated to improve performance and minimize safety concerns. The flight articles, which are electrically operated, are not strong enough to lift themselves on Earth (though they can manipulate tens of thousands of pounds in zero gravity).

Breathing Gas

Because of the pressures encountered at depth, all divers use oxygen-enriched breathing gas (commonly called Nitrox) to reduce the probability of experiencing the bends after long training sessions.

Environmental Control

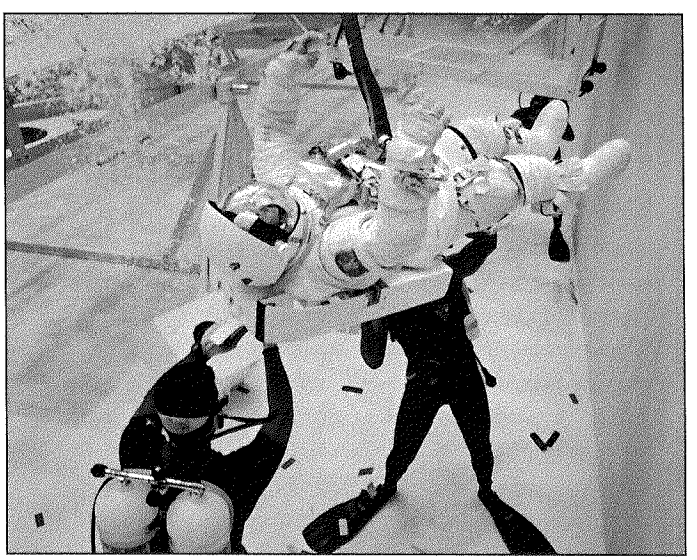
Both breathing gas (Nitrox) and cooling water are provided to each spacesuit through umbilicals. The flight spacesuits are self-contained and do not require an umbilical.

Closed-Circuit Television System

Video coverage of all training activities is accomplished using hard-mounted and handheld cameras. The video is used by the topside trainers and simulation control team and is also transmitted to onsite training facilities.

Water Treatment System

The water within the NBL is recycled every 19.6 hours. It is automatically monitored and controlled to a temperature of 82-88 degrees Fahrenheit to minimize the potential effects of hypothermia on support divers. It is also chemically treated to control contaminant growth while minimizing long-term corrosion effect on training mockups and equipment.



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FS-2006-11-026-JSC