**Hull and Compartments**

**Is the USS *Pampanito* (SS-383) really a submarine?**

That is actually a valid question. Modern submarines, even the non-nuclear boats of other navies, don’t look anything like the *Pampanito* from the outside. They are sleek black shapes and are mostly underwater. Only a little of the hull shows along with the upright sail. Unlike the *Pampanito,* they have no guns. But, yes, this is what was described as a submarine in World War 2.

**What do you mean when you say this is what we called a submarine?**

This is as far as the technology could go in the early 1940s. However, these boats, and all others of that era, technically, were just submersibles. They were surface ships that could submerge for relatively brief periods (usually 16 hours or so), could fight submerged and then could come back to the surface. The first true submarine was the USS *Nautilus* (SSN-571) which was commissioned in 1954. With nuclear power she could operate underwater for months at a time and did not have to surface regularly for fresh air or to recharge batteries. She was designed to operate underwater for the vast majority of the time.

**How different are modern submarines?**

Visitors who have served on our latest submarines tell us that they are completely different from the *Pampanito* and exactly the same. They are telling us that the functions are the same – diving, surfacing, being quiet, being sneaky, gathering intelligence, and attacking the ships of an enemy in wartime. How those functions are accomplished may be very different. Buttons, switches and computers help to accomplish many tasks that were very manual on the *Pampanito*. In addition, modern submarines are much larger and cleaner. However, there isn’t enough space to play basketball.

***Pampanito* is much bigger than I expected. I thought submarines were crowded.**

The boat is long but narrow. It is almost 312 feet long. However, the pressure hull, where the crew lived and worked, is only 16 feet in diameter and around 280 feet long. The bottom level is all machinery and much more equipment is on the main level such as the tops of the engines and generators, fresh water stills, torpedo tubes, reload torpedoes and the boat’s controls. As a result, there isn’t much room left for the crew.

The submarine looks much bigger from the outside than it does from the inside, particularly with 80 crew members on board.

**Is a submarine a boat or a ship?**

Most often the difference between boats and ships is based on size and whether the vessel is ocean-going. A boat is generally a smaller vessel that can be carried by a ship. A ship cannot be carried by a boat. Other vessels that are generally too large to be carried may also be referred to as boats such as ferry boats, tour boats and fishing boats.

By this definition, submarines such as the *Pampanito* are technically ships. However, the original submarines were boats by the formal definition. They were carried to the point of attack and were not suitable for lengthy ocean transits. As a result, by tradition, all submarines are still referred to as boats even though some of the newer ones are huge in comparison. Submarines can be referred to both as ships and boats, with “boats” being far more common.

**Is the submarine a battleship?**

That depends on your definition of a battleship. These submarines were combatant ships and did go into battle. However, in WW2, there was a specific type of ship called a battleship. Those ships were large, heavy vessels with many guns. The biggest of our battleships had nine 16-inch guns and as many as 20 five-inch guns, 48 Bofors 40 mm guns in mounts of four, and 52 Oerlikon 20 mm guns each. The battleships we built were 25 times larger, by displacement (or heavier), than the *Pampanito*.

In WW2, submarines were certainly in battles, but were not referred to as battleships.

**Where is the pressure hull? Can I see it from the pier?**

The pressure hull or “people pipe” is below the main deck and between the sets of ballast and fuel tanks on both sides of the boat. Most of the pressure hull is hidden by the tanks on both sides and the main deck above.

**Where do the torpedoes come out?**

The outer doors for the forward tubes are all the way forward and just below the first row of limber holes. It is a rectangular structure that moves in toward the boat when opened. The same is true of the after tubes although there are no limber holes near the after outer doors.

The outer doors for the top tubes, both forward and aft are visible on the *Pampanito.* You can see the outline of the rectangular doors. That is because the boat is currently much lighter than it was when it was operational. It does not have the 100 tons of battery cells, the nearly 400 tons of fuel, the full complement of torpedoes with live warheads, the food for the crew plus the 80 sailors and their gear. If that were all on board, the boat would be sitting deeper in the water and the torpedo doors would be under water.

**What should we know about before discussing what is in the boat?**

A few definitions for common words and phrases might be helpful, such as hatches, heads, ladders and watertight doors.

**What is a “hatch”?**

A hatch is an opening through a deck that allows a sailor to move up or down using a ladder.

**What is a “head”?**

In the Navy, a head is a toilet. There are four heads on board, although only two are visible.

**What is a “ladder”?**

A ladder, in Navy speak, is a set of stairs or steps on a ship. Most of the original ladders on the *Pampanito* actually resemble the almost straight up and down ladders around your home. However, they were not as easily moved. Surface ships have ladders that look more like stairs. Those are similar to what was added in the torpedo rooms for visitors and old docents to enter and exit the *Pampanito* museum.

**What is a “watertight door”?**

A watertight door is the opening between the compartments on a submarine. The doors are very heavy since they are designed to withstand sea pressure. This is so they can prevent flooding from moving from one compartment to the next. At a depth of 400 feet, the outside water pressure is about 175 PSI. The weight needed to withstand that pressure helps to explain their small size.

There are no watertight doors on the lower level. To go from one compartment to the next on that level, one would have to go up to the main level, move to the desired compartment, and then go back down.

**Why are there so many doorways to go through?**

The submarine is divided up into eight compartments on the main level. (The Conning Tower is a separate compartment above the pressure hull.) These compartments are designed so that if any one of them were to be flooded, the boat could still get back to the surface. (That is a theory that may never have been proven during actual operations.) The compartments are also divided functionally so that noise and light can be suppressed, particularly at night.

**Why are the watertight doors so heavy?**

See the definition of watertight doors, above.

**What are the compartments on these submarines?**

We will be starting aft, or at the back of the boat, which is where both tours – online and in person - start. The following are the various compartments, plus the bridge, along with the significant equipment in each:

**After torpedo room including:**

* Four torpedo tubes, which would normally be loaded, plus four reload torpedoes.
* Crew’s bunks above the torpedoes
* A signal gun to send out flares or decoy devices.
* There is no lower level in this compartment since the propellor shafts pass through this area.
* This space has the unique head that discharges directly over the side and cannot be used in port or when submerged. It requires an eight-step process to flush since the water level outside the boat is significantly higher than the water and waste in the bowl. If flushed incorrectly, the user gets to clean up the mess.
* After escape trunk.
* Charging unit for the Mark XVIII electric torpedoes.

**Maneuvering room including:**

* The cubicle which is where power is distributed.
* The large levers direct the power from an engine-generator combination either to the battery charge or to operate the boat. These are separate circuits. When the boat is submerged, the levers are changed to take the power from the battery to operate the boat.
* Main motors on the lower level to drive the propellors via the reduction gears. There are two motors per propellor shaft.
* Motor order telegraphs. These receive the orders from the bridge of conning tower for the desired speed. They are then used to acknowledge the orders received and being executed. There are two units, one for each propellor shaft.
* Lathe for repairs.
* An inverter to provide A/C power from the D/C battery or generators.
* Log (or engineer’s) office. This tiny space is the second largest office on the boat.

**After engine room including:**

* Two Fairbanks Morse, 10 cylinder, opposed-piston main engines producing about 1,500 horsepower each. The engines extend to the lower level.
* Two generators (one attached to each engine) to produce the needed electrical power.
* A smaller, “donkey” diesel on the lower level that can be used to top off a battery charge. This is a smaller Fairbanks-Morse, 7 cylinder, opposed-piston engine with associated generator. These smaller engines were removed from active submarines in the 1950s.
* Clean fuel tank.
* Normal lube oil tank.
* Associated fuel and oil pumps and filters.

**Forward engine room including:**

* Two more Fairbanks-Morse main engine-generator combinations that also extend to the lower level.
* Two Kleinschmidt stills for fresh water.
* Air conditioning on the lower level. This has been described as functioning more as a dehumidifier rather than actual air conditioning. In other words, in WW2 it removed some moisture but didn’t cool the air very well.
* Clean fuel tank.
* Normal lube oil tank.
* Associated fuel and oil pumps and filters.

**After battery including:**

* Crew’s sinks, heads and showers. The two heads are behind the metal doors opposite the wash machine.
* Half of the boat’s battery, 126 cells, is on the lower level.
* Fan unit to pull the hydrogen out of the battery well so it does not reach combustible levels when charging the battery. The air from the battery well is dumped into the engine rooms so the hydrogen can be burned.
* Main crew’s berthing with 36 bunks.
* Pharmacist mate’s medical locker.
* Locker to hang service dress uniforms.
* Smaller lockers for personal items. Some smaller items would be stored under the mattresses.
* Ice cream machine.
* Crew’s mess with four tables seating six men each. Two tables have game boards embedded.
* Galley, the small space next to the crew’s mess where meals are cooked. The third cook, the overnight baker, prepares bread, rolls, cakes and pies in this space.
* A large coffee maker; coffee is always available.
* The ammunition locker is on the lower level, port side forward. The access hatch may be under the chest used for storage and seating.
* Cold storage on the lower level.
* Limited pantry space on the lower level.
* Sinks to wash dishes.

**Control room. This is where the crew dives the boat, controls depth and returns to the surface. It includes:**

* Radio room with radios and encoding/decoding equipment.
* Controls for the low-pressure blower, used to empty ballast tanks of the last of the water.
* Periscope wells. The actual periscopes cannot be seen inside the wells nor can they be used from here.
* High-pressure air manifold used to bring the boat back to the surface.
* AC electrical switchboard.
* Alarms – diving, collision and general quarters (battle stations) on one of the pericope wells.
* Announcing systems.
* Trim manifold.
* Air search radar.
* IFF query and display.
* Diving officer’s checklist.
* Radar equipment.
* Bow and stern plane control wheels.
* Ladder and hatch up to the conning tower.
* Hatch and ladder down to the pump room.
* Chief of the watch station with the “Christmas Tree” display of the status of key valves and hatches.
* Controls to main ballast tank vents.
* Controls to special ballast tanks and main induction.
* LORAN (Long Range Aid to Navigation).
* Gyrocompass.
* Bathythermograph.
* Fathometer.
* Boat’s safe topped by a ladder up to the main deck. This hatch has a small window to allow gun crews to see if the water above the hatch has drained away.
* Backup helm.
* Backup gyrocompass.
* Magnetic compass.
* Dead reckoning tracker. The display of *Pampanito’s* war patrols is on this DRT.

Note: The control room on the *Pampanito* is configured with red lights to show an example of the typical lighting at night.

**The pump room which is below the control room.**

* Air compressors.
* Trim pumps.
* Drain pumps.
* Hydraulic pumps.
* The low-pressure blower to empty ballast tanks of the last of the water.
* On some boats, the safe is located here.

**Conning tower – the enclosed space above the control room including:**

* Hatch and ladder down to control room
* Helm.
* Course indicator.
* Rudder indicator.
* Motor order telegraphs.
* Alarms.
* Announcing systems.
* Ladder and hatch to the bridge.
* Sonar displays and controls.
* SJ surface search radar display and controls.
* ST surface search radar display. This radar is in the search periscope.
* Depth gauge.
* Telegraph key.
* Two periscopes, search and attack.
* Dead reckoning tracker.
* Torpedo data computer.
* Torpedo firing keys.
* Radio phone sets.
* Sound-powered phones.

**Bridge – the open space above the conning tower** **including:**

* Target bearing transmitters.
* Announcing systems.
* Lookout platforms on the periscope shears.
* Signal lamp.
* Course indicator.
* Ships’ guns including 20 mm and 40 mm, as installed.

Returning to the main level inside the pressure hull forward of the control room, we have the **forward battery including:**

* Boat’s office. This is the large office on the boat.
* Chief petty officers’ berthing, also known as the “goat locker”.
* Captain’s cabin with desk and depth and course indicators.
* The other half of the boat’s battery, 126 cells, is on the lower level.
* Fan unit to pull the hydrogen out of the battery well.
* Officers’ berthing.
* Wardroom for officers’ meals, meetings and work space.
* Serving galley. Food is kept warm and served from here. It is not cooked here.

**Forward torpedo room**

* Six torpedo tubes (also normally loaded) and 10 reloads in skids (trays).
* Crew’s bunks above the torpedoes.
* Sonar equipment. Sonar can be operated from here, but there is no PPI display.
* Charging unit for the Mark XVIII electric torpedoes.
* Escape trunk.
* Officers’ head and shower.
* This space has a shallow lower level that includes two of the six torpedo tubes and two of the reloads.

**The control room has a lot of equipment. Is it the command center?**

Yes, it has a lot of equipment. No, it is not the command center. That would be either the conning tower, which is above the control room, or the bridge. The conning tower is the command center when the boat is submerged. It is always manned when at sea by a helmsman and quartermaster since steering and navigation are normally done from this space. Radar and sonar are also normally operated from this space. It would be very crowded during general quarters (battle stations) for submerged attacks with as many as 10 to 12 men in the space.

The conning tower is only about 20 feet long and 10 feet in diameter. It is made of slightly thicker steel due to its vulnerability since it is closer to the surface.

The bridge is the command center, where the officer of the deck will normally be, when surfaced. When on the surface, the officer of the deck is supported by the crewmen in the conning tower and control room. This is particularly true when attacking on the surface.

**Are there enough heads on the boat? We only see two.**

There are four heads on the Pampanito. Two are in the main berthing area. They have metal doors and are opposite the washing machine. There is one additional head in each of the torpedo rooms. And, yes, four heads are normally enough for the 80-man crew.

**Why are the chiefs’ quarters known as the goat locker?**

This is the space where the Chief Petty Officers, the highest-ranking enlisted men, sleep. The space is so named because the chiefs are the “old goats” in the Navy. On a submarine in WW2, they were as “old” as 28 or 30 years old.

In this case, goat is not necessarily GOAT, as in greatest of all time. Nor does it imply that the chiefs smelled more like goats than the rest of us. After a few days at sea, we all smelled pretty bad.

The chiefs’ quarters are known as the goat locker throughout the Navy, not just on submarines.