

FORCES

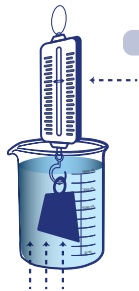
The overall design of submarines involves a careful balance of these forces and principles to achieve effective propulsion, control, and submersion. Engineers consider the buoyancy requirements, hydrodynamic properties, and the integration of various systems to ensure the submarine's safety and functionality in different underwater conditions.

Term - Definition

Why it's used in Submarines



Ensign



1. Buoyancy

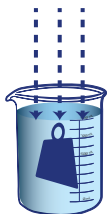
:tendency of an object to float or to rise in a fluid when submerged.

Buoyancy is the upward force exerted by a fluid (in this case, water) that opposes the weight of an immersed object (the submarine). Submarines are designed to be buoyant, allowing them to float at the water's surface or at a specific depth. By controlling buoyancy, submarines can submerge or surface.

Principle Used: Archimedes' Principle



Lieutenant Junior Grade



2. Gravity

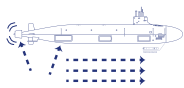
:the universal force of attraction acting between all matter.

As a submarine moves through water, it experiences resistance due to the water's viscosity. This resistance is an opposing force that the submarine's propulsion system must overcome.

Principle Used: Principles of fluid dynamics, including drag force equations.



Lieutenant



3. Propulsion

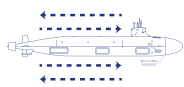
:the action of driving or pushing forward.

Submarines use propulsion systems, often powered by electric or diesel-electric engines, to generate forward thrust. The propulsion system must overcome hydrodynamic resistance to move the submarine through the water.

Principle Used: Newton's Third Law of Motion



Lieutenant Commander



4. Hydrodynamic Resistance:

:the extra resistance induced by a particle as it flows through a microfluidic channel.

As a submarine moves through water, it experiences resistance due to the water's viscosity. This resistance is an opposing force that the submarine's propulsion system must overcome.

Principle Used: Principles of fluid dynamics, including drag force equations.

FORCES

Let's continue to learn about the several different forces that submarines use based on principles of fluid dynamics, propulsion, and buoyancy.

Term - Definition

Why it's used in Submarines



Commander



5. Control Surfaces

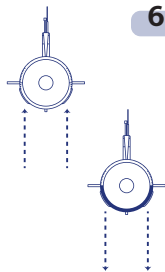
also known as hydroplanes, are control surfaces found on a submarine which allow the vessel to submerge, surface, and controls depth when submerged.

Submarines have control surfaces, such as fins and rudders, that are used to control their orientation and depth. By adjusting these surfaces, a submarine can ascend, descend, and maintain stability.

Principle Used: Principles of aerodynamics & hydrodynamics in the design of control surfaces for stability and maneuverability.



Commander



6. Ballast Tanks

are used to control the buoyancy of the vessel by filling the tanks with water or air.

Submarines are equipped with ballast tanks that can be filled with water or emptied of water to control buoyancy. When the tanks are filled, the submarine becomes denser and sinks; when emptied, it becomes less dense and rises.

Principle Used: Archimedes' Principle

