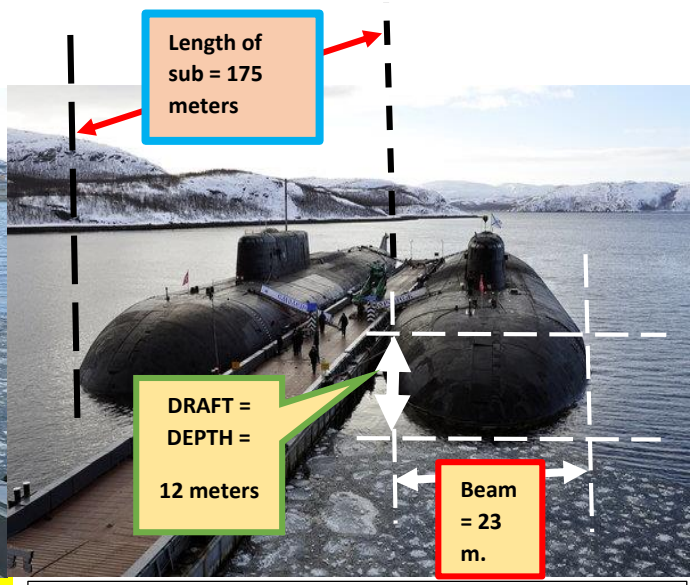
FLUIDS

Unit 18 Dr. John P. Cise , Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu & New York Times April 21, 2016 by Eric Schmitt

Russia Bolsters Its Submarine Fleet, and Tensions With U.S. Rise

Nuclear-powered submarines at a base in Russia's Murmansk region.



Two nuclear-powered cruise-missile submarines, Smolensk, left, and Voronezh, at a base in northern Russia in March.

Moscow has increased submarine patrols in the past year.

NAPLES, Italy — Russian attack submarines, the most in two decades, are prowling the coastlines of Scandinavia and Scotland, the Mediterranean Sea and the North Atlantic in what Western military officials say is a significantly increased presence aimed at contesting American and NATO undersea dominance.

To be sure, there is hardly parity between the Russian and American submarine fleets. (((Russia has about 45 attack))) submarines — about two dozen are nuclear-powered and 20 are diesel — which are designed to sink other submarines or ships, collect intelligence and conduct patrols. But Western naval analysts say that only about half of those are able to deploy at any given time. (((The United States has 53 attack submarines, all nuclear-powered.))) as well as four other nuclear-powered submarines that carry cruise missiles and Special Operations forces. At any given time, roughly a third of America's attack submarines are at sea, either on patrols or training, with the others undergoing maintenance.

Sub dimensions: (from Wikipedia)

Type:	Ballistic missile submarine
Displacement:	23,200–24,500 t (22,830–24,110 long tons) surfaced 33,800–48,000 t (33,270–47,240 long tons) submerged
Length:	175 m (574 ft 2 in)
Beam:	23 m (75 ft 6 in)
Draught:	12 m (39 ft 4 in)
Propulsion:	2 × OK-650 pressurized-water nuclear reactors, 190 MWt each

INTRODUCTION: Purpose of this application is to verify the displacement (mass of water displaced by sub hull = ~ 48,000 tonns…see data facts in table at left from wikipedia) of sub when fully submerged. Consider sub hull to be rectangular solid as seen in graphic in upper right. **Archimedes principle** states objects are buoyed up by a force equivalent weight of water displaced.

HINTS: $\rho_{WATER} = 1000\ kg./m^3$, $\rho = m/V$,

ANSWERS: (a) ~48,300 $m.^3$, (b) 48.3 X 10^6 kg. (or 48,300 tonns) ……note: tonn = 1000 kg. , (c) ~ 24 X 10^6 kg. (or 24,000 tonns).

COMMENT: Displacement obtained from Archimedes principle for total submerged and ½ submerged(floating) Displacement Confirms Wikipedia data in above table.

QUESTIONS: (a) Find total volume of sub? (b) Find mass of water displaced by sub when fully submerged? (c) About ½ of sub is out of water when floating (see graphics above). Find (confirm) displacement of sub when surfaced?