

MIT Department of Mechanical Engineering
2.25 Advanced Fluid Mechanics

Problem 7.12

This problem is from “Advanced Fluid Mechanics Problems” by A.H. Shapiro and A.A. Sonin

Consider an incompressible flow through a series of geometrically similar machines such as fans, pumps, hydraulic turbines, etc. If Q denotes volume flow, ω rotational speed, D impeller diameter, μ fluid viscosity, and ρ fluid density,

- (a) show that dynamic similarity requires that $Q/\omega D^3$ and $\rho Q/\mu D$ be fixed.
- (b) Show that if $Q/\omega D^3$ and $\rho Q/\mu D$ are fixed in a series of tests, then $\Delta P/\rho \omega^2 D^2$ must remain constant, where ΔP is the change in head across the machine, expressed in pressure units.
- (c) Find the form of the relation between the work output per unit mass of fluid W , and the the given variables, in a series of tests where $Q/\omega D^3$ and $\rho Q/\mu D$ are fixed.

MIT OpenCourseWare
<http://ocw.mit.edu>

2.25 Advanced Fluid Mechanics
Fall 2013

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.