

Fluids

I. Ideal Fluid

Real fluids are complicated as their properties depend upon the nature of the forces between the molecules of the fluid as well as forces between the fluid and the container.

Energy from the fluid can be transferred to internal energy states of the molecules and well as the container. The density of the fluid can change under pressure. We will therefore use a model that is simpler and provides the basic properties of a fluid. This model is called an ideal fluid.

- A. Steady Flow** – The velocity of a moving fluid at a specific point doesn't change over time.

It makes no sense to talk about the velocity of a river at a specific point if the velocity is constantly changing in some unpredictable way.

Steady flow is also called Laminar Flow (means sheets) in which each sheet of fluid moves in an easy and predictable manner.

Non-steady flow is called Turbulent Flow and it can be quite complex.

Many fluids change from laminar to turbulent flow as the speed of the fluid increases above some specific value. This can dramatically change the properties of the fluid.

- B. Incompressible Flow** – The density of the fluid has a constant value throughout the fluid.
- C. Nonviscous Flow** – This is akin to not having friction in earlier mechanics problems. We will assume no energy lost due the motion of the fluid. Viscosity is a measure of the fluids resistance to motion. All fluids have some viscosity. Glass for instance is a very viscous fluid while water has low viscosity. Oil has viscosity which is why pumping stations are required along a pipeline to add energy to the oil so as to keep the oil flowing.
- D. Irrotational Flow** – The fluid doesn't rotate like in a whirl pool.

II. Streamlines – A streamline is a graphical picture of the flow of a small piece of fluid as it travels over time.

1) The velocity of the fluid at each point is tangent to the streamline at that point.

2) Streamlines never cross.

Activity: You can see streamlines by watching leaves or bubbles in a stream or by placing a few drops of dye in a moving fluid.