

Drag force

The force on an object by a fluid to resist its motion through it is called the drag force. If the fluid is air, then it is called aerodynamic drag force. Motion through fluids is easy as any object can make a way through it. Fluids certainly are treated as materials, i.e., having both mass and volume. Material things resist changes in their velocity and no two material things may occupy the same space at the same time.

The drag force can be determined from the Bernoulli's equation for the pressure in a fluid, which states that for an ideal liquid flow (a liquid with no viscosity), an increase in the speed of the fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy. A common form of Bernoulli's equation, valid at any arbitrary point along a streamline, is:

$$P + \rho gh + \frac{1}{2} \rho v^2 = \text{constant}$$

There are three terms in the equation for the total pressure and are defined as:

P : the part of the pressure which comes from outside the fluid and is referred to the atmospheric pressure.

ρgh : the gravitational contribution to pressure.

$\frac{1}{2} \rho v^2$: the kinetic or dynamic contribution to pressure — the part related to flow. This term will help us understand the origin of the drag force.

Start with the definition of pressure as force per area and then solving it for force:

$$P = \frac{F}{A}$$

$F = PA$ and substituting the dynamic contribution to pressure

$$F = \left(\frac{1}{2} \rho v^2 \right) A$$

OR

$$F = \frac{1}{2} \rho C A v^2$$

Here C is the coefficient of drag, which depends the shape of the object subject to the flow of fluid and also takes into account other factors like texture, viscosity, compressibility, lift, boundary layer separation, and so on.. All these factors are combined to give one factor called the coefficient of drag (C).