MEC516/BME516: Fluid Mechanics I

Chapter 3: Control Volume Analysis

Demo: The Bernoulli Effect

RYERSON UNIVERSITY
Department of Mechanical & Industrial Engineering

Overview

- Video Demonstration

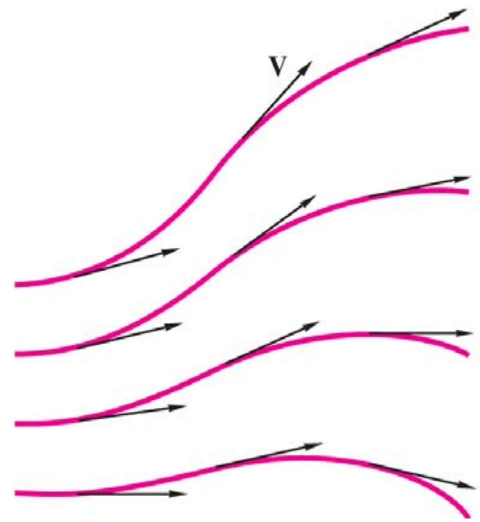
- Recall, on a streamline:

pressure energy per unit mass

$$\frac{V^2}{2} + \frac{p}{\rho} + gz = const$$

kinetic energy per unit mass

potential energy per unit mass

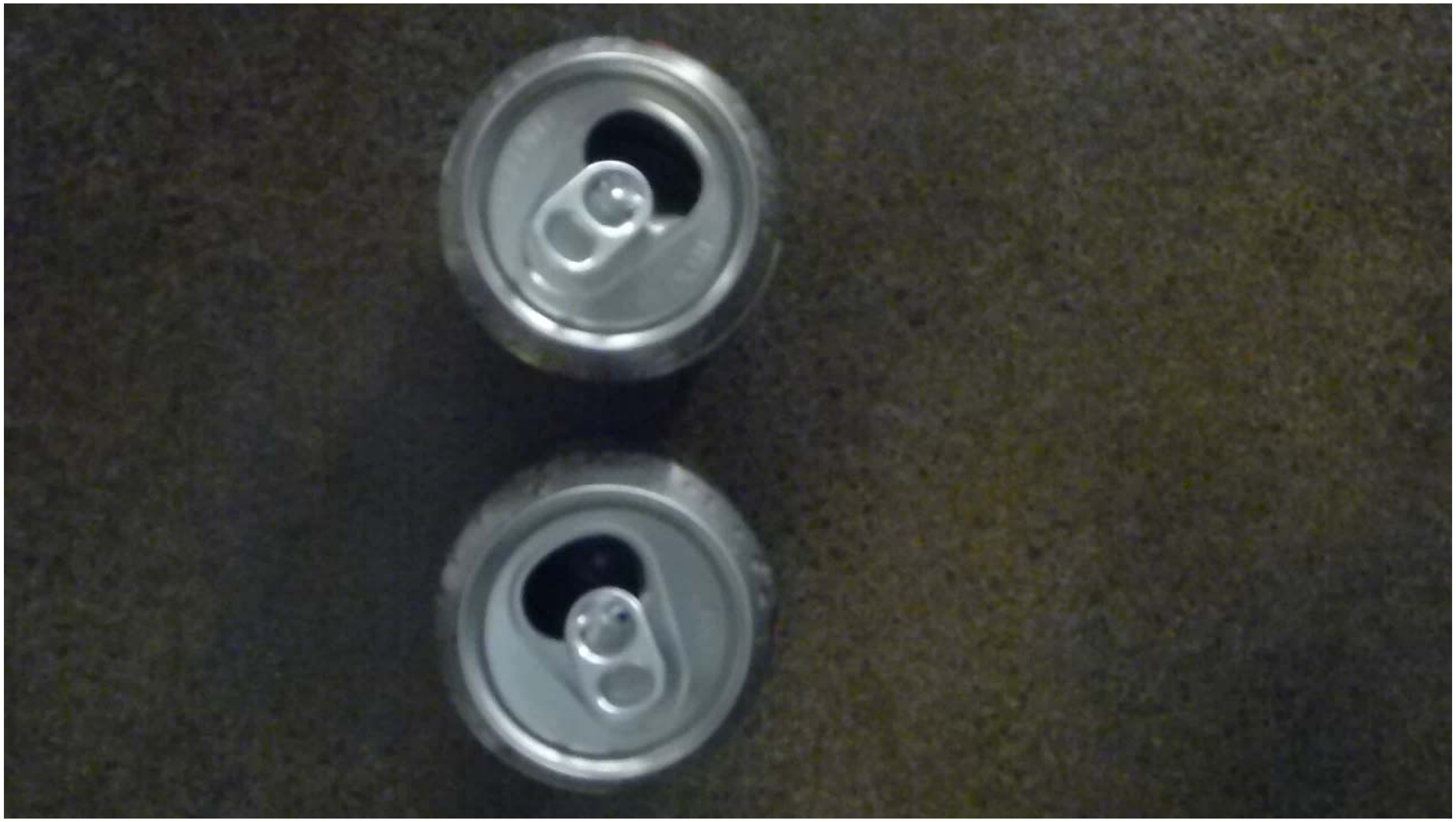


- Local fluid velocity **V** is tangent to streamlines.

- no flow crosses a streamline

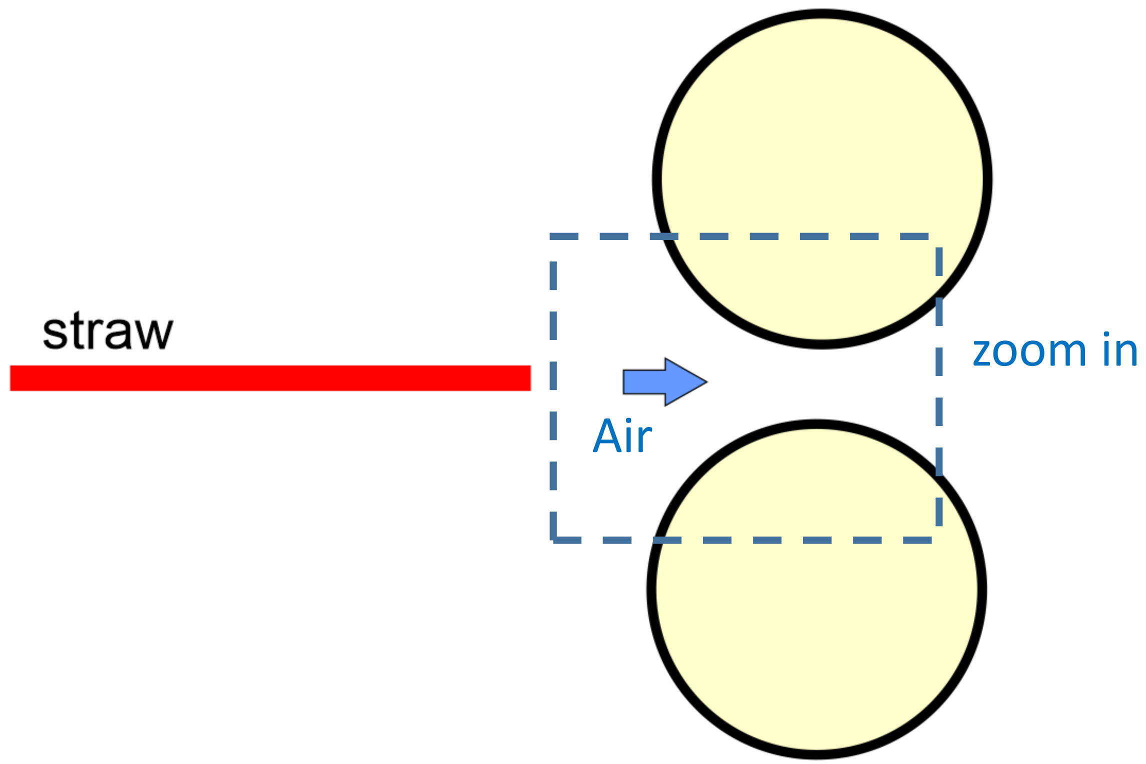
Video Demo: Bernoulli Equation

Top view of two empty pop cans



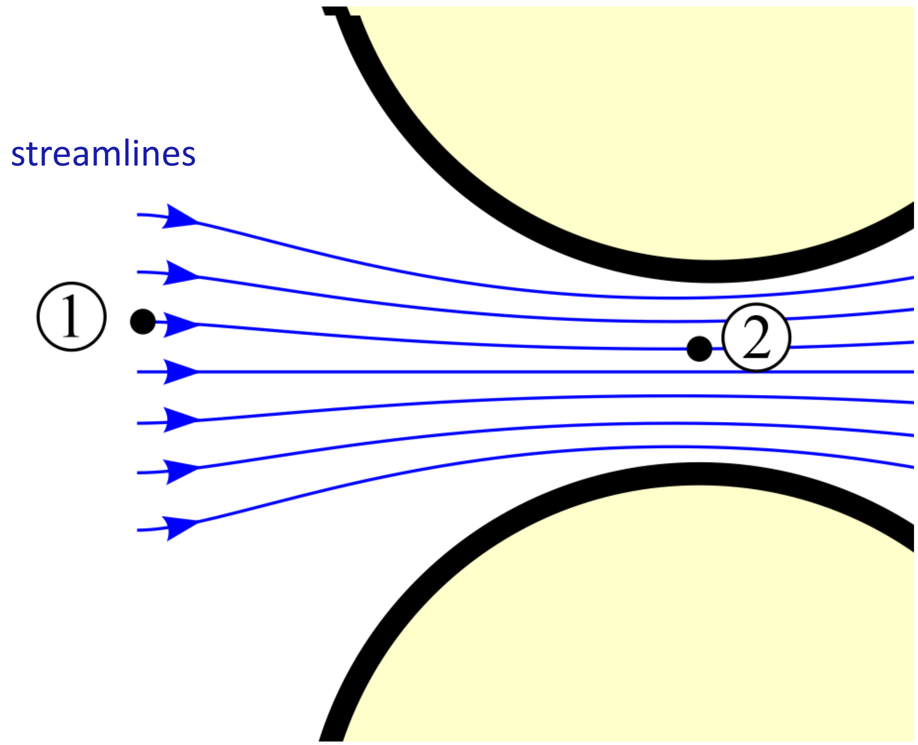
Video Demo: Bernoulli Equation

Top View of Empty Pop Cans



Video Demo: Bernoulli Equation

Top View of Empty Pop Cans



Write the Bernoulli Equation on
any streamline, from point 1 to point 2:

$$\frac{1}{2}V_1^2 + \frac{p_1}{\rho} + gz_1 = \frac{1}{2}V_2^2 + \frac{p_2}{\rho} + gz_2$$

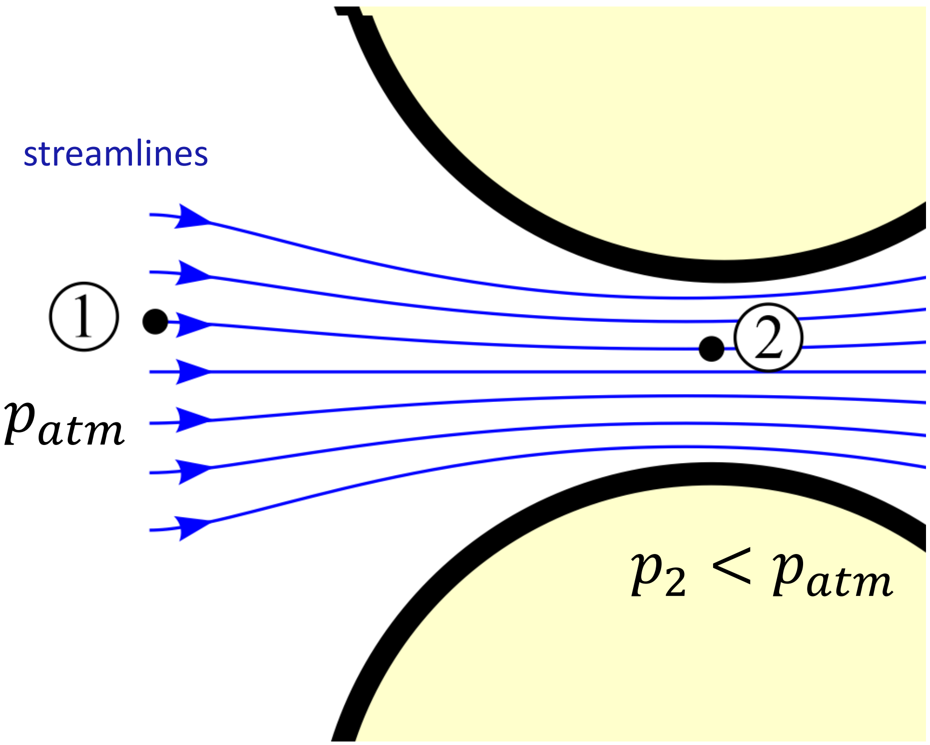
Video Demo: Bernoulli Equation

Top View of Empty Pop Cans

The Bernoulli Equation:

$$\frac{1}{2}V_1^2 + \frac{p_1}{\rho} = \frac{1}{2}V_2^2 + \frac{p_2}{\rho}$$

$p_1 \approx p_{atm}$



By continuity $V_1 A_1 = V_2 A_2$

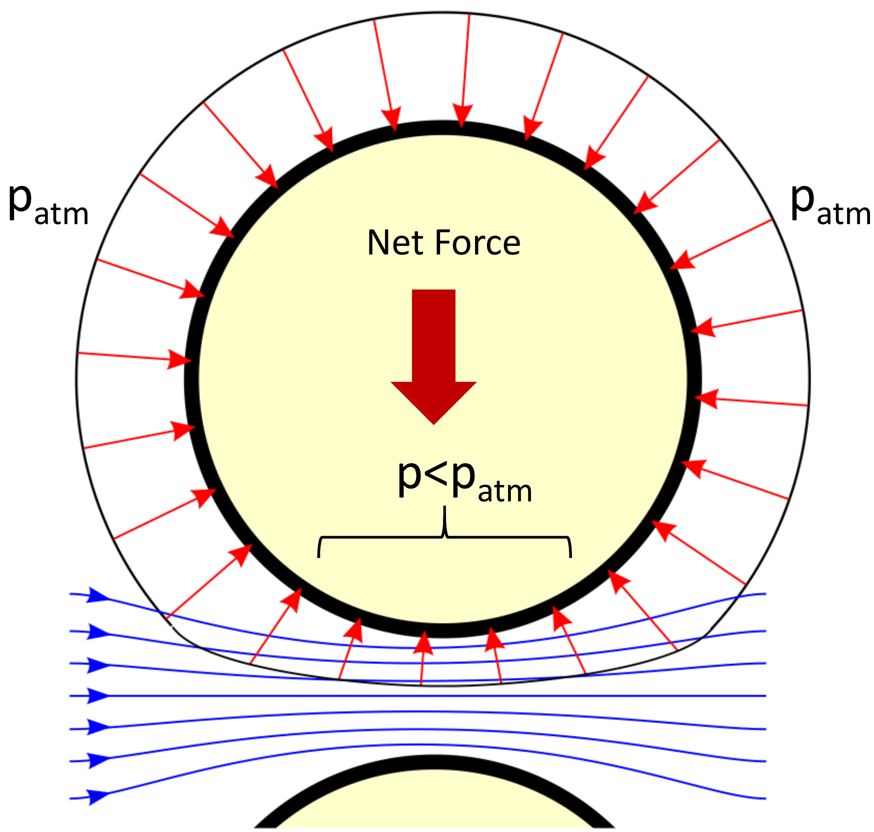
We can see that $A_2 < A_1$ Thus, $V_2 > V_1$

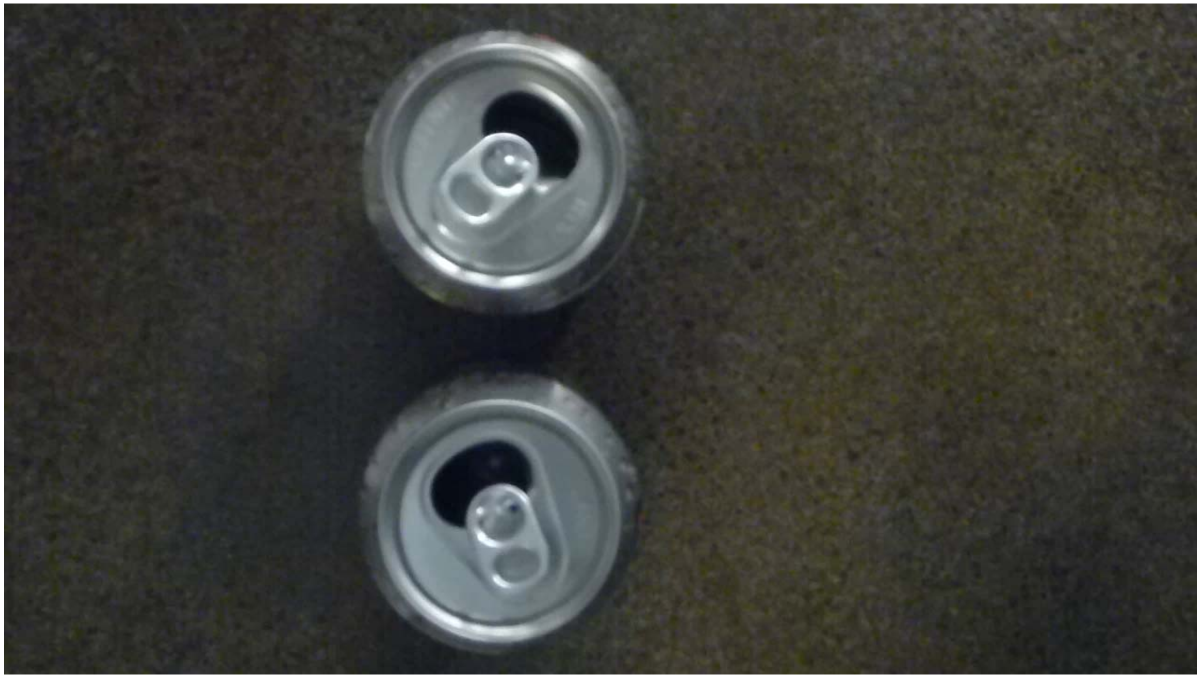
Flow has more kinetic energy at ② than at ①

So, the pressure energy at ② must be lower than at ①. Thus, $p_2 < p_1$

Video Demo: Bernoulli Equation

Consider the radial pressure distribution around one can





END NOTES

Presentation prepared and delivered by Dr. David Naylor.