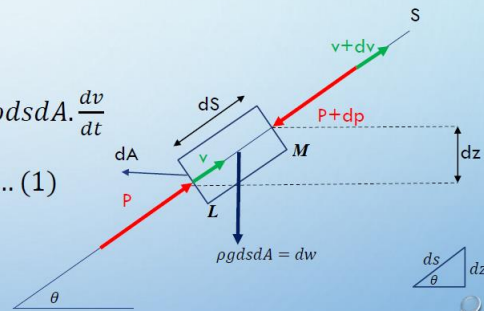


Energy Equation:(Bernoulli's Equation)

- $\sum F_s = m \cdot a$
- $PdA - (P + dP)dA - \rho g ds dA \sin\theta = \rho ds dA \cdot \frac{dv}{dt}$
- $-dPdA - \rho g ds dA \sin\theta = \rho ds dA \cdot \frac{dv}{dt} \dots (1)$
- From Tringle :
- $\sin\theta = \frac{dz}{ds} \quad \therefore ds \sin\theta = dz \dots (2)$
- From Chain Rule : $\frac{dv}{dt} = \frac{dv}{ds} \cdot \frac{ds}{dt} = \frac{dv}{ds} \cdot v \dots (3)$



Applications of Bernoulli's Equation - Finding Pressure ...

PITOT TUBE

- Also known as Pitot probe, is a **pressure measurement** instrument used to measure **fluid flow velocity**.
- The pitot tube was invented by the French engineer **Henri Pitot** in the early 18th century and was modified to its modern form in the mid-19th century by **French scientist Henry Darcy**

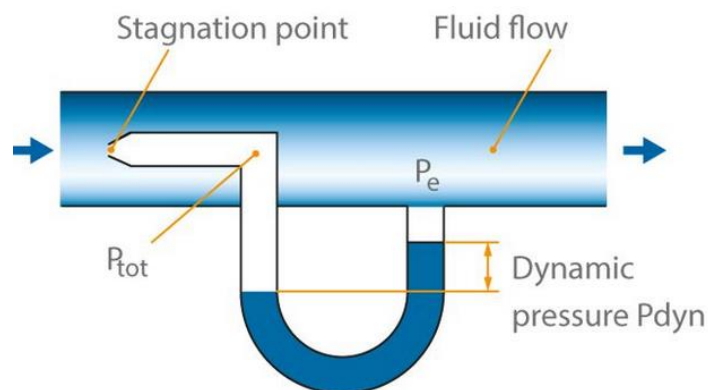
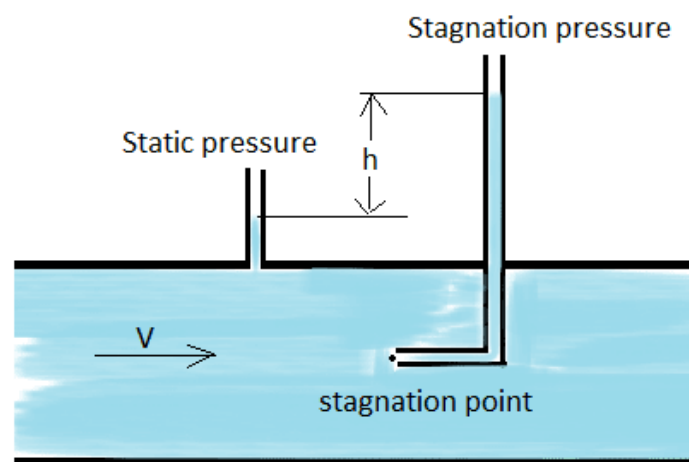


The principle of flow measurement by Pitot tube was adopted first by a French Scientist Henri Pitot in 1732 for measuring velocities in the river. A right angled glass tube, large enough for capillary effects to be negligible, is used for the purpose. One end of the tube faces the flow while the other end is open to the atmosphere.

It is basically a fluid velocity measuring instrument that can also be used for [flow measurement](#) of liquids and gases. It consists of two hollow tubes that sense pressure at different places within the pipe. This hollow tubes can be mounted separately in a pipe or installing together in one casing as a single device. One tube measures the stagnation or impact pressure and another tube measures only static pressure usually at the wall of the pipe.

WORKING PRINCIPLE

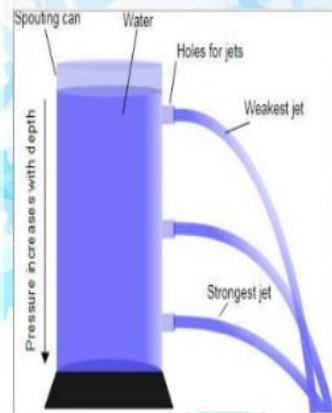
- The basic pitot tube consists of a tube pointing directly into the fluid flow.
- As this tube contains fluid, a pressure can be measured.
- The moving fluid is **brought to rest** (stagnates) as there is no outlet to allow flow to continue. This pressure is the **stagnation pressure** of the fluid



1. STATIC PRESSURE

- Static pressure, (hydrostatic pressure) is the **pressure of a fluid at rest**.
- Since the fluid is not moving, static pressure is the **result of the fluid's weight**.

$$P_{\text{static}} = \text{Force/Area}$$



+

2. DYNAMIC PRESSURE

- When a fluid is moving through a pipe, there is a second component to the pressure. It is called **dynamic pressure**.
- Dynamic pressure is a **pressure exerted perpendicular** to the direction of the flow and is represented by the symbol q

$$q = \frac{1}{2}\rho V^2$$

ρ = fluid density equal to mass/volume in units of g/cm^3 or slug/ft^3

V = velocity of fluid in units of m/s or ft/s

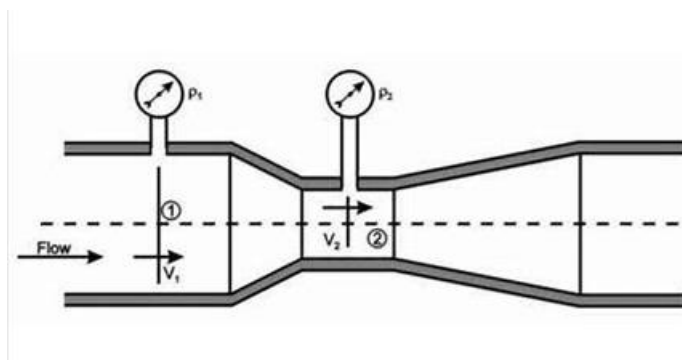
a slug is a unit of mass with the units $\text{lb} \cdot \text{s}^2/\text{ft}$

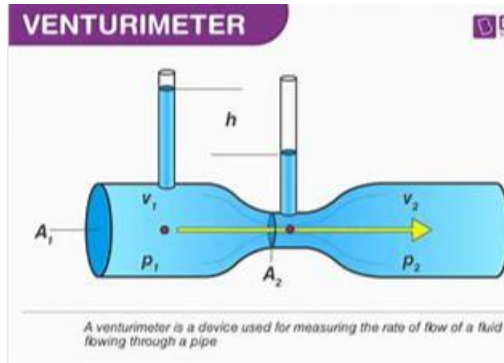
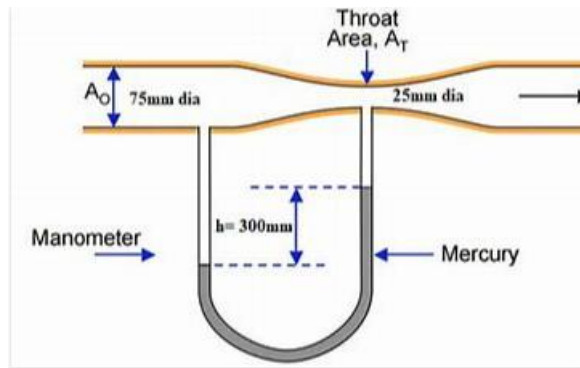
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TOTAL (STAGNATION) PRESSURE

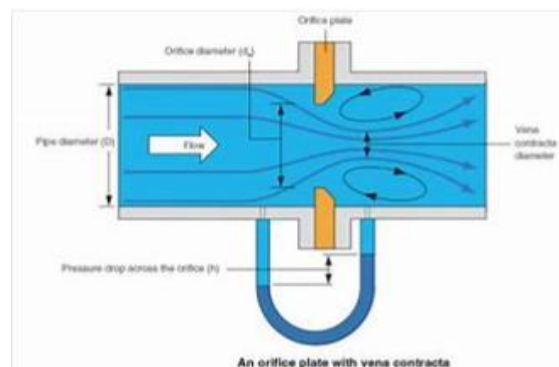
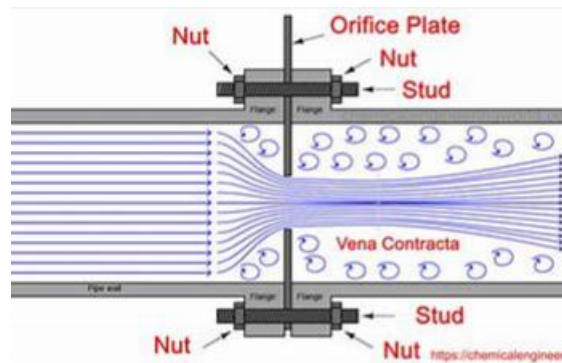
- Stagnation pressure is equal to the sum of the dynamic pressure and static pressure.
- The magnitude of stagnation pressure can be derived from a simplified form of **Bernoulli Equation**.
- For incompressible flow, $P_{\text{stagnation}} = \frac{1}{2}\rho v^2 + P_{\text{static}}$
 - ρ is the fluid density,
 - v is the velocity of fluid

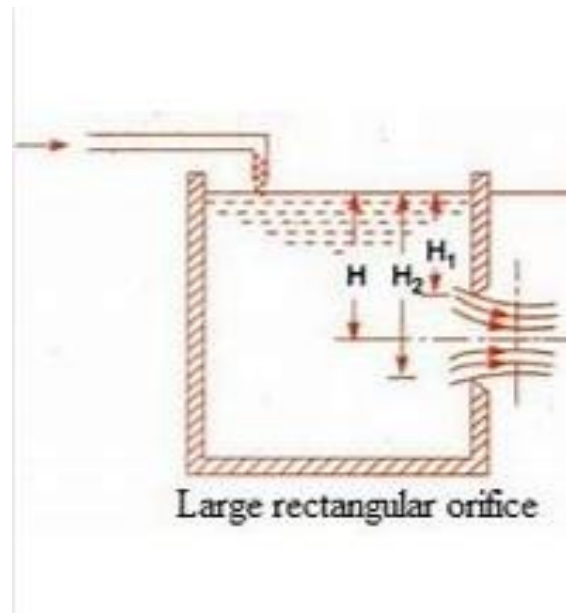
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