**Formulas**

In the rest of this document we will apply each formula between a point A and point B

Pa: pressure at point A (Pa)

Za: altitude at point A (m)

Ua: velocity of the fluid at point A (m.s-1)

Qv: volumic flow rate (m3.s-1)

Sa: passage section at point A (m²)

Um: average velocity (m.s-1)

ρ: density of the fluid (m3.s-1)

**Venturi tubes:**

Bernoulli formula

Flow rate equality:

⬄) ⬄

**Orifice plates**

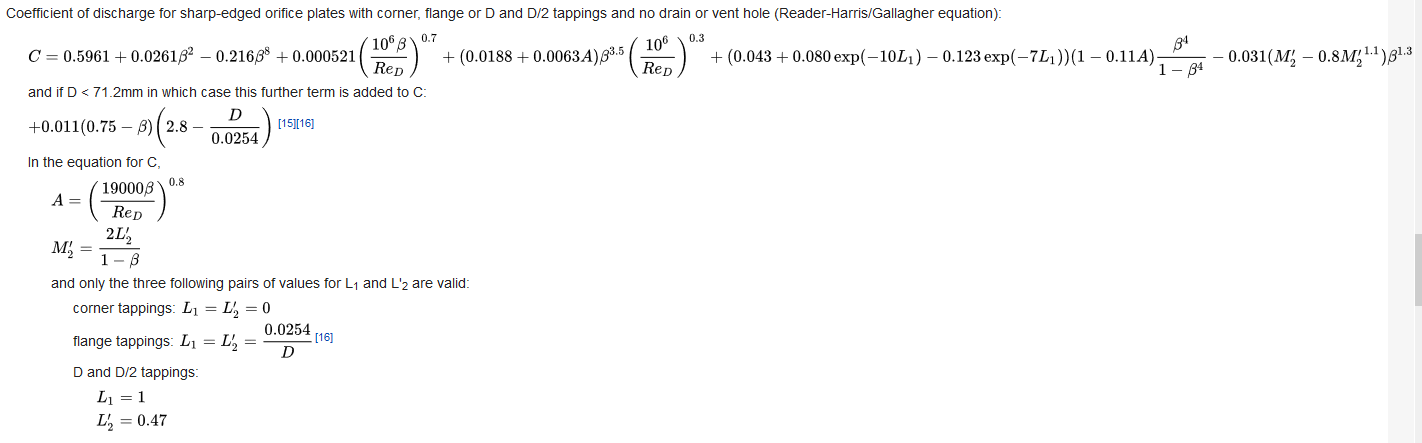
Bernoulli formula

Flow rate equality:

⬄) ⬄ introducing the Cd coefficient (because it is not a perfectly laminar flow) and the β=d/D, d diameter of the orifice (m), D diameter of the pipe (m)

Introducing C= Sb0 area of the orifice

Coefficient of discharge can be calculated with the Reader-Harris/Gallagher equation:

Extracted from Wikipedia.org

An expansibility factor can be introduced for compressible fluids.

**Head losses**

-linear head losses (major losses):

Darcy-Weisbach formula: ξ regular head lose coefficient

-Laminar flow:

-Turbulent flow in a smooth pipe: (Blasius fromula)

-Turbulent flow in a rough pipe: (Colebrook formula)

- Singular head losses (minor losses): K singular head losse coefficient

For a non-circular pipe, the diameter DH is S: passage section (m²); P: perimeter (m)

**Bernoulli equation**

For a Newtonian, homogeneous, incompressible fluid, in a stationary movement.

For an ideal fluid

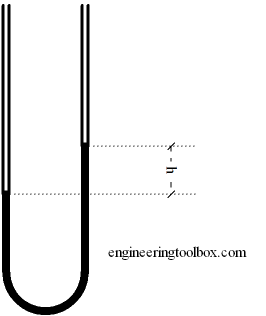
For a real fluid

**Fundamental of aerodynamic and wind tunnel**

Lift force:

Drag force Cd and Cl are determined by the experience

Reynolds’s number: Lc characteristic length (wing rope for an aircraft diameter for a pipe)

**U tube**

p2

z2

p1

z1

Between the point 1 and the rest of the installation (It is the same for the point 2), the fluid is static so p1=Pa or Pb depending the connection.