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Continuity Equation

To understand the **continuity equation** it helps to consider the **flow rate**  $f$  first :

$$f=Av$$

the flow rate describes the volume of fluid that passes a particular point per unit time (like how many liters of water per minute are coming out of a pipe).  $A$  is the cross-sectional area of the pipe at any point,  $v$  is the average speed of the flow at that point.

## Continuity Equation

A pipe, with a fluid (e.g. air) in it is considered, where one part is wider than the other :

$$v_1/t = v_2/t$$

since  $v = s/t$  ( $s$  is the distance from each point of the cross-section part):

$$A_1 \cdot s_1/t = A_2 \cdot s_2/t$$

$A_1$  is the area of the cross section of the pipe's wider part,  $A_2$  the cross-section area of the pipe's narrow part ;  $v_1$  and  $v_2$  show the velocity of the fluid passing through  $A_1$  and  $A_2$ . The fluid in the pipe has a *laminar flow* (no troubles in it, steady) and is **incompressible**, which means the *density* is constant → in the same time intervals the same volumina of the fluid will pass through each cross section of the pipe. According to the **continuity equation**, a fluid will pass more rapid through the narrow part of the pipe. The flow speed is higher in the constricted part of the pipe. The wider the pipe is, the slower is the flow speed, if the pipe narrows, the flow speed will increase.

*The conclusion of it is, that the flow speed is inversely proportional to the cross-sectional area of the pipe.*