

## Dye Injection:

Dye can be used to mark and visualize particular regions of flow or individual fluid streamlines. To mark streamlines adjacent to a test body, dye is injected from small ports on the surface of the object. [<http://kahuna.sdsu.edu/%7esharring/12ps.html>].

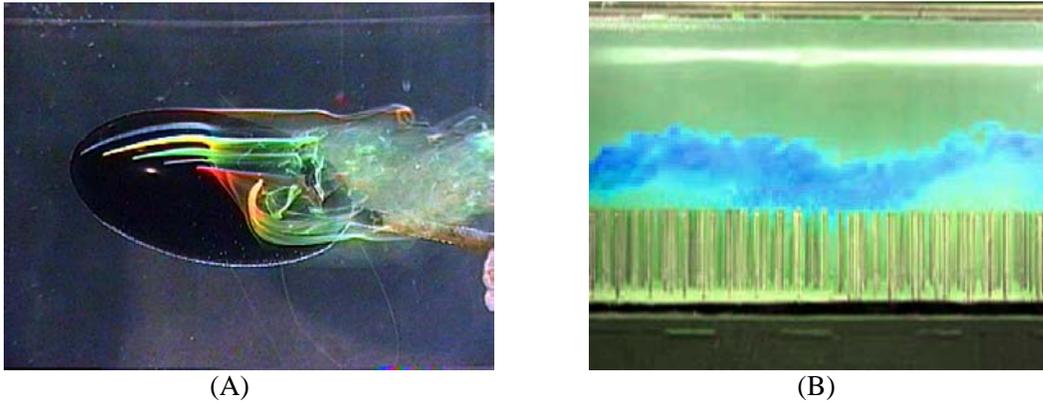
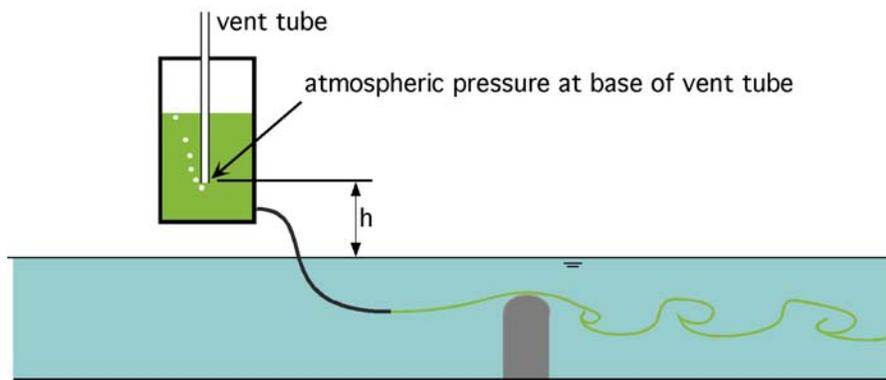


Image A. from Flometrics, Solana Beach, Ca. [<http://kahuna.sdsu.edu/%7esharring/12ps.html>]. Copyright (C) 2002 by. All Rights Reserved. Image B. contribute by Marco Ghisalberti. Tracer plume reveals flow structure above submerged canopy.

To mark streamlines within the fluid, dye can be released from a thin needle aligned to the local flow. In the latter case care must be taken to minimize disruption to the existing flow field. For example, the injection velocity should match the local velocity. The injection velocity can be controlled either with a syringe pump or a constant head reservoir, such as the Mariotte bottle described in the figure below.



**Figure 1.** A Mariotte bottle delivers tracer at constant rate, even as the reservoir is depleted. The bottle is sealed except for a vent tube. As the reservoir empties, air bubbles are drawn into the bottle to equalize the pressure. The pressure at the tip of the vent tube is maintained at atmospheric pressure. Evaluating Bernoulli's Equation between the tip of the vent tube and the point of dye injection into the flume gives the velocity of the injected dye,  $V_{\text{dye}} = \sqrt{2gh}$ .

To ensure that the tracer faithfully follows the undisturbed flow field, the density of the tracer must match that of the experimental fluid. For example, consider a water channel experiment. Most dyes are heavier than water and must be mixed with alcohol to achieve neutral density. Remember that density is also a function of temperature, such that a neutrally buoyant dye prepared for a tank at room temperature will not be neutrally buoyant if the tank is refilled with fresh colder water. Finally, you will note that in most of the examples given below a blue dye is viewed against a white backdrop, because this offers the best contrast.

Dye Injection Examples.

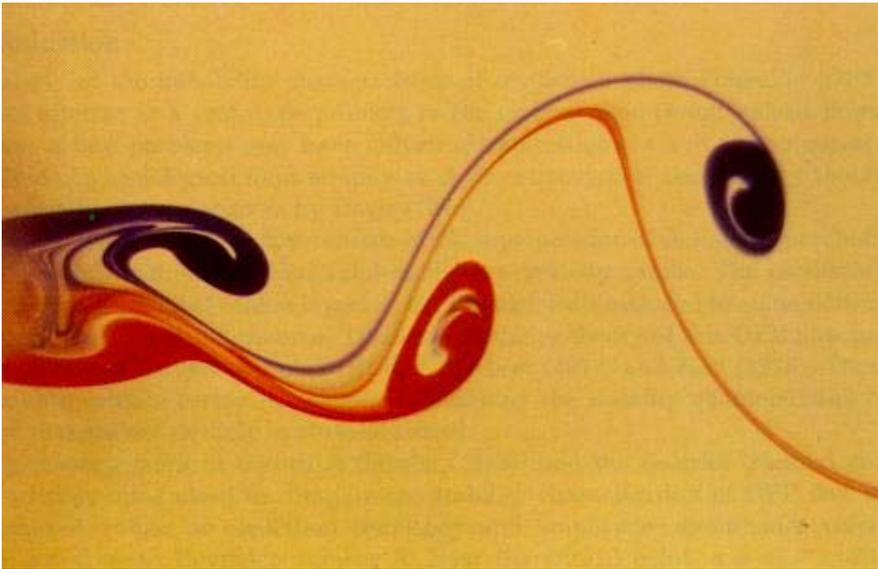


Image from <http://www.eng.nus.edu.sg/mpelimtt/Karman1.JPG>

See also

<http://www.eng.nus.edu.sg/mpelimtt/collision.mpg>

<http://www.eng.nus.edu.sg/mpelimtt/leapfrog.mpg>

<http://www.eng.nus.edu.sg/mpelimtt/collid998.JPG>