TFES Lab (ME EN 4650)
Flow Visualization

Required Figures

Importantly, you will need to edit your flow visualization images (e.g. in Powerpoint, Adobe Photoshop, Xfig, Gimp, or some other program) to crop out extraneous area in the image, highlight only the flow features of interest, and add arrows with annotations as needed. In addition, state the corresponding Reynolds number for each of the images. An example of an annotated sequence of snapshots is shown in Figure 1.

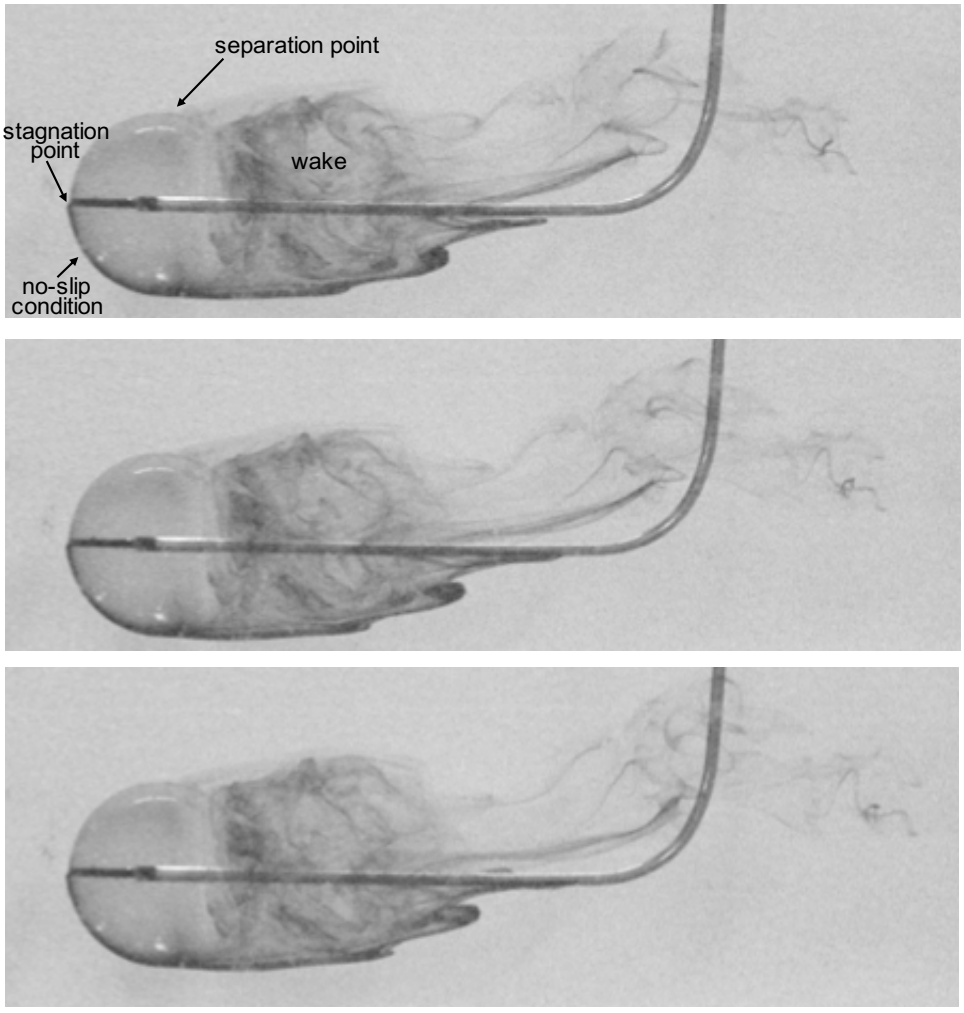

Figure 1. Streaklines around a sphere at a Reynolds number based on diameter of Re_D = 2800. A sequence of three snapshots are shown with a time of 91 ms between each snapshot. Flow is from left to right. The streaklines are marked by neutrally-buoyant dye injected from the stagnation point at the front of the sphere.

1a. Cylinder at low speed (1 snapshot). This figure needs to include annotation of the relevant fluids phenomenon along with the Reynolds number based on the cylinder diameter.

1b. Cylinder at medium speed (multiple snapshots). This figure needs to include a sequence of snapshots taken at different times, up to four images. No annotation is required.

1c. Long flat plate at medium speed (1 snapshot). This figure needs to include annotation of the laminar flow region and transition region, along with the Reynolds number of the flow at the location at which transition appears to occur. Remember that the Reynolds number for a flat plate is based on the distance x from the leading edge.

1d. Long flat plate at low and high speeds (2 snapshots). This figure needs to include two images, one for laminar boundary layer flow and one for turbulent boundary layer flow. No annotation is required.

1e. Airfoil at an angle of attack of 8° and medium speed (1 snapshot). This figure needs to include annotation of the relevant fluids phenomenon along with the Reynolds number based on the chord length.

1f. Airfoil at a range of angle of attacks and medium speed (3 snapshots). This figure needs to include images taken at the following approximate angles of attack: 0°, 4°, $>8^\circ$. No annotation is required.

1g. Other shape (1–3 snapshots). Multiple images may be included in this figure, if they convey the time-varying nature of the flow. However, annotation is only required in one of the images. Include the Reynolds number of the flow in the annotation.

Short-Answer Questions

2a. Write one paragraph (using appropriate fluids terminology) that describes the differences in flow phenomena observed between the low and high Reynolds number cases for the cylinder.

2b. Write one paragraph that discusses the limitations of the dye-injection technique you used in the lab. Suggest an alternative flow visualization technique that might provide better (or additional) information about the flow fields you examined. You will need to perform some research (using the internet or textbook) to answer this question. Include a citation for the reference used.