

Experimental Setup and Procedure

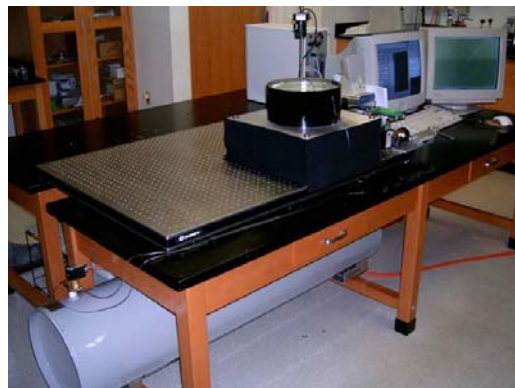
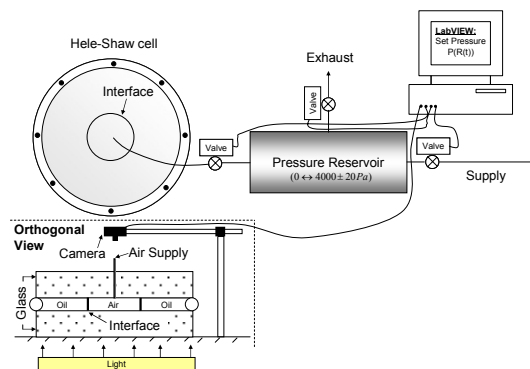


Fig 1: Experimental Apparatus: schematic and photograph of setup

The experimental apparatus is shown in Figures 1 and 2. The Hele-Shaw cell was constructed from two circular glass plates, (full size telescope blanks) each with 3.5cm thickness and 20cm diameter. The surfaces of the glass plates were hand polished to flatness. A 1.4mm hole was drilled in the center of the top plate, into which a hypodermic syringe needle, ground flat at one end, was glued. The two glass plates were separated by 4 polyester spacers of thickness 0.5mm symmetrically placed around the circumference. Two compression rings, bolted together, were used to hold the cell windows together.

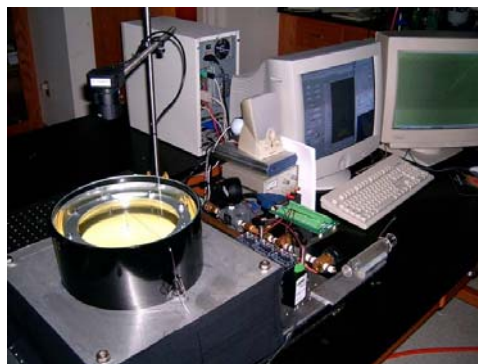
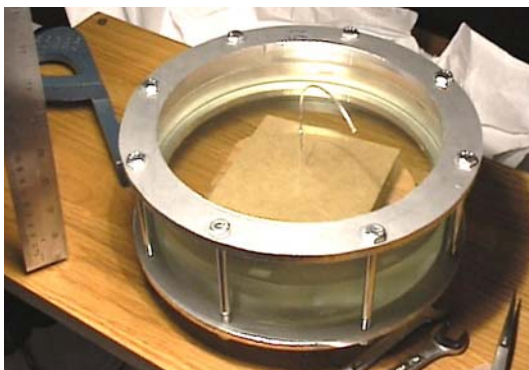


Figure 2. The Hele-Shaw cell.

The entire cell was immersed in a container of castor oil. The level of the oil was above that of the cell gap. A glass cover was placed above the cell to keep out contaminants.

Air was held in a pressure tank (diameter 0.36m and length 1.53m , volume 0.156m^3) in the pressure range $0 - 3000\text{ Pa}$. Pressure was measured with AutoTran Series 860 gauges, with 2% accuracy. The inlet of the pressure tank was connected to a 4kPa high-pressure source via a solenoid gate valve; the exhaust port

opened to the room via a solenoid gate valve, and the outlet was connected to the Hele-Shaw cell via another solenoid gate valve.

The experiment was computer controlled via LabVIEW. Pressure in the tank was measured. If the pressure was less than the set value, the inlet valve was opened; if it was greater than the set value, the exhaust valve opened. The minimum time the valves were open was $9ms$. The pressure in the tank could be controlled to better than within $20Pa$ of the set value.

The initial bubble was created in the cell by a hand-operated syringe; the subsequent pressure was controlled, as a function of time, by the LabVIEW program.

Illumination was provided by a $40W$ circular fluorescent light and a ground glass diffuser plate below the cell. Pictures were taken with a Viewbits CMOS Uroria 3MPix USB camera, using an $f/1.8$, 6-13mm lens at 1fps. The resolution of the captured images is $\sim 1mm$.