Example 2:

A classic type of manometer is a U-tube with two legs of equal length. The tube is generally filled with a dense liquid such as oil, water, or mercury (depending on the range of pressures to be measured). A measurement of the change in height of the liquid between the two legs is used to calculate the pressure difference using the hydrostatic equation. A typical application is to measure the pressure change across a flow device as shown, where the density of the fluid in the flow is $\rho_1$ and the density of the fluid in the U-tube is $\rho_2$. Derive a formula for the pressure difference $p_a - p_b$ in terms of the system parameters.

**Known:** U-tube manometer across a flow device, $L$, $h$, $\rho_1$, and $\rho_2$

**Assumptions:** Static fluid, incompressible liquid, negligible surface tension effects

**Find:** Algebraic expression for $p_a - p_b$ as a function of $L$, $h$, $\rho_1$, and $\rho_2$

**Solution:**

**Answer:** $p_a - p_b = (\rho_2 - \rho_1) g h$