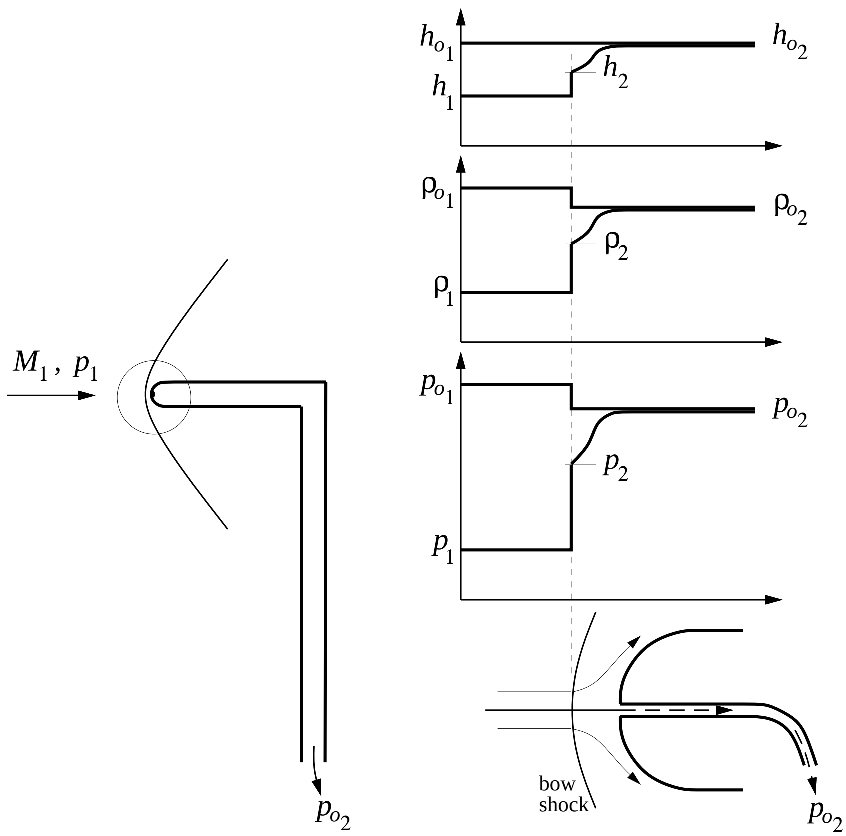

In addition, we also have M_2 and p_2/p_1 as functions of M_1 from the earlier normal-shock analysis. Combining these produces the relation between the p_{o_2} measured by the pitot probe, the static p_1, and the required flow Mach number M_1. After some manipulation, the result is the *Rayleigh Pitot tube formula*.

$$\frac{p_{o_2}}{p_1} = \frac{p_{o_2}}{p_2}\frac{p_2}{p_1} = \left(\frac{(\gamma+1)^2 M_1^2}{4\gamma M_1^2 - 2(\gamma-1)}\right)^{\gamma/(\gamma-1)} \frac{1-\gamma+2\gamma M_1^2}{\gamma+1} \tag{4}$$

The figure shows p_{o_2}/p_1 versus M_1, compared with the isentropic ratio p_{o_1}/p_1.

$$\frac{p_{o_1}}{p_1} = \left(1 + \frac{\gamma-1}{2}M_1^2\right)^{\gamma/(\gamma-1)} \tag{5}$$

Only the latter is plotted for $M_1 < 1$, where there is no bow shock, and so equation (4) does not apply. The effect of the pitot bow shock's total pressure loss, indicated by the difference $p_{o_1} - p_{o_2}$, becomes substantial at larger Mach numbers.

Ideally, we would like to have the pitot formula (4) give M_1 as an explicit function of the pitot/static pressure ratio p_{o_2}/p_1. However, this is not possible due to its complexity, so a numerical solution is required. The function is also readily available in table form.