Given: $\rho = 0.5\,\rho_{SL}$ $\quad a = 0.95\,a_{SL}$ $\quad \mu = 0.95\,\mu_{SL}$ → tunnel quantity

$\ell = 4\,\ell_{SL}$ (characteristic length) (span, chord, whatever)

a) To match M_∞, must have $\frac{V}{a} = \frac{V_{SL}}{a_{SL}} \rightarrow V = 0.95\,V_{SL}$

To also match Re, must have $\frac{\rho V \ell}{\mu} \stackrel{?}{=} \frac{\rho_{SL} V_{SL} \ell_{SL}}{\mu_{SL}}$

or $\frac{\rho}{\rho_{SL}} \frac{V}{V_{SL}} \frac{\ell}{\ell_{SL}} \stackrel{?}{=} \frac{\mu}{\mu_{SL}}$

$0.5 \cdot 0.95 \cdot 4 \stackrel{?}{=} 0.95$ ✗ not possible

Cannot simultaneously match M_∞ and Re without being able to adjust another parameter (like ρ!)

b) Tunnel quantities: $\rho_T\ a_T\ \mu_T\ V_T\ \ell_T$

Unknown: ρ_T

Given: $a_T = a_{SL} = \frac{1}{0.95}\,a$

$\mu_T = \mu_{SL} = \frac{1}{0.95}\,\mu$

$\ell_T = \frac{1}{4}\,\ell$

→ because $T_T = T_{SL}$ as given

Require $M = M_T \rightarrow \frac{V}{a} = \frac{V_T}{a_T} \rightarrow V = 0.95\,V_T$

Require $Re = Re_T \rightarrow \frac{\rho V \ell}{\mu} = \frac{\rho_T V_T \ell_T}{\mu_T}$

$$\rho_T = \rho \cdot \frac{V}{V_T} \frac{\ell}{\ell_T} \frac{\mu_T}{\mu} = \rho \cdot 0.95 \cdot 4 \frac{1}{0.95} = 4\rho$$

or $\boxed{\rho_T = 2\,\rho_{SL}}$

From equation of state: $\boxed{p_T = p_{SL}\left(\frac{\rho_T}{\rho_{SL}}\right)^2\left(\frac{T_T}{T_{SL}}\right)^1 = 2\,p_{SL} = 2\,\text{atm.}}$