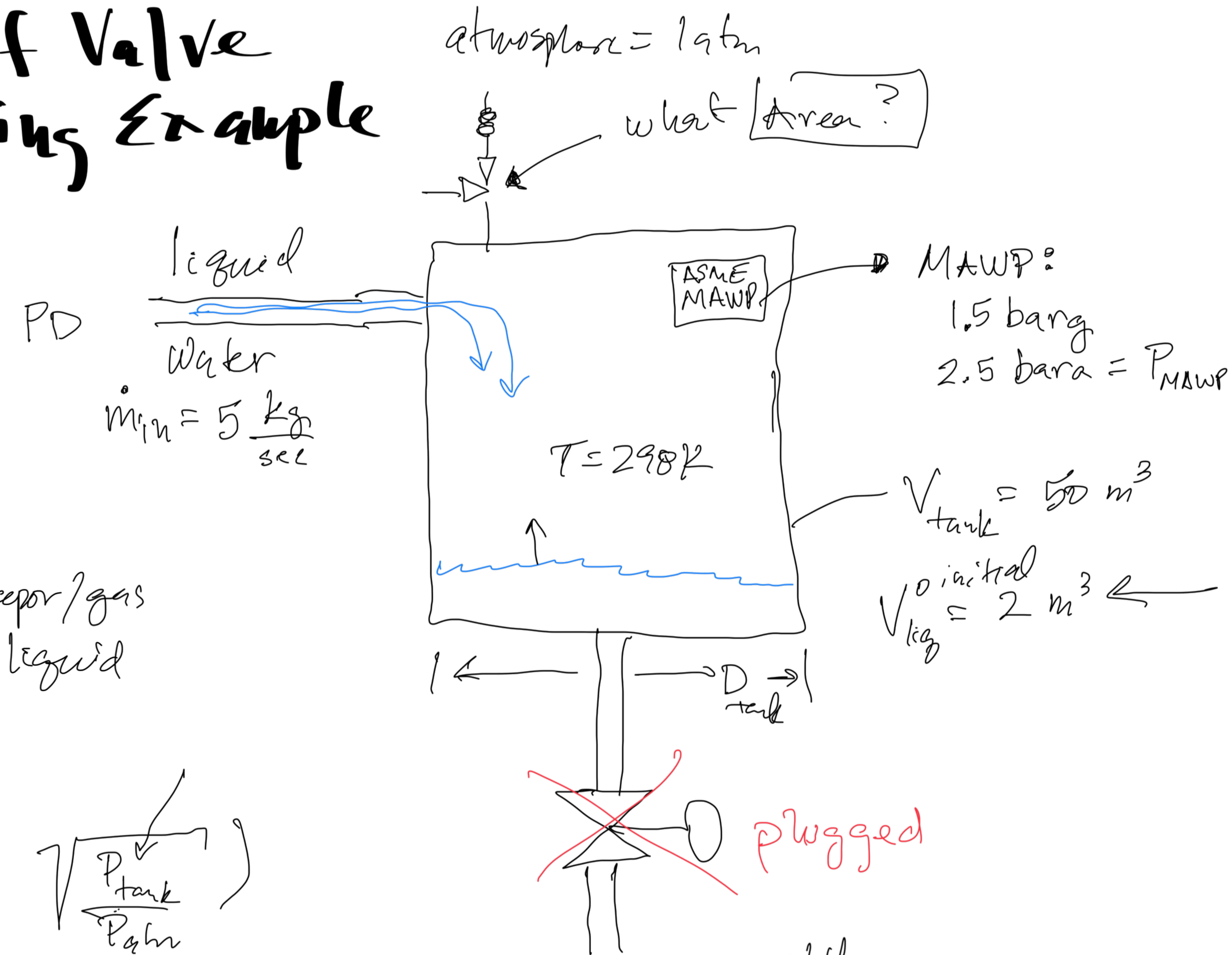
Relief Valve Sizing Example



$P^{tank}_{max} = 1.1 \cdot 1.5$ barg
$= 1.65$ barg
$= 2.65$ bara

① Vent vapor/gas
② vent liquid

$Ma = \min\left(1, \sqrt{\frac{P_{tank}}{P_{atm}}}\right)$

$Ma = 1$

$\dot{m} = M_w\, P_0\, A\, C_d \sqrt{\frac{\gamma}{R\,T\,M_w}} \cdot 1 \cdot \left[1 + \frac{(\gamma-1)}{2}\cancel{Ma^2}\right]^{\frac{\gamma+1}{2-2\gamma}}$

2.75 bara, 0.95, 1.4, 1.4

= some # but what is A? or what $\dot{m}$?

Next step? to get A?

What is $\dot{m}_{gas}$? or how is the volume changing?

$\dot{m}^{H_2O}_{in} = 5\ \frac{kg}{sec}$ $\quad \dot{V}^{water} = \frac{\dot{m}^{water}_{in}}{\rho_{water}} = \dot{V}^{gas} \longrightarrow \rho_{gas}\dot{V}^{gas} = \dot{m}^{out}_{gas}$

not constant

$\rho_{gas}\left(@\ P = P^{max}_{tank}\right)$
venting condition
2.65 bara

$A_{gas} = \frac{\dot{m}_{gas}}{P_0\ C_d [\ldots]}$

Will A_{gas} sufficient for liquid?

$\dot{m} = A\, C_d \sqrt{2\rho\,(P_{tank} - P_{atm})}$

0.65 — liquid density

$\dot{m} = 5\ \frac{kg}{sec} \quad [=] \quad \overset{A}{m^2}\sqrt{\frac{kg}{m^3} \cdot \frac{kg \cdot m}{m^2\, s^2}} \quad [=] \quad m^2 \cdot \frac{kg}{s \cdot m^2}$

$A = \frac{\dot{m}}{C_d\sqrt{2\rho\,(P_{tank} - P_{atm})}}$