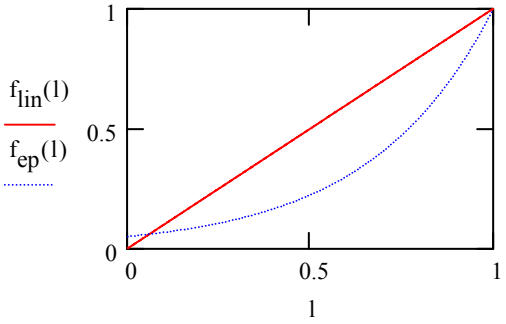
9.4

$$q = C_v \cdot f(l) \cdot \sqrt{\frac{\Delta P_v}{g_s}}$$

lift equations

$R := 20 \quad f_{ep}(l) := R^{l-1}$ for equal percentage

$f_{lin}(l) := 1$ for linear



$g_s := 1.11$

$q_{50} := 200$

$\Delta P_{cond.50} := 30 \qquad \Delta P_{cond}(q) = c_q \cdot q^2 \qquad c_q := \frac{\Delta P_{cond.50}}{q_{50}^2} \qquad c_q = 7.5 \times 10^{-4}$

$\Delta P_T = \Delta P_v + \Delta P_c \qquad \Delta P_v = \Delta P_T - \Delta P_c = \Delta P_T - c_q \cdot q^2$

$$q = C_v \cdot f(l) \cdot \sqrt{\frac{\Delta P_v}{g_s}} = C_v \cdot f(l) \cdot \sqrt{\frac{\Delta P_T - c_q \cdot q^2}{g_s}}$$ ΔP_v is not constant

$$q^2 = \left(C_v \cdot f(l)\right)^2 \cdot \frac{\Delta P_T - c_q \cdot q^2}{g_s}$$ solve for q

$$g_s q^2 + \left(C_v \cdot f(l)\right)^2 \cdot c_q \cdot q^2 = \left(C_v \cdot f(l)\right)^2 \cdot \Delta P_T$$

$$q = \sqrt{\frac{\left(C_v \cdot f(l)\right)^2 \cdot \Delta P_T}{g_s + \left(C_v \cdot f(l)\right)^2 \cdot c_q}}$$

part a)

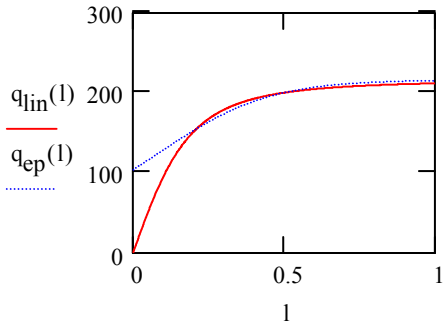
$\Delta P_{v.50} := 5 \qquad \Delta P_T := \Delta P_{v.50} + \Delta P_{cond.50} \qquad \Delta P_T = 35$

$$C_{v.linear} := \frac{q_{50}}{f_{lin}(0.5)\cdot\sqrt{\frac{\Delta P_{v.50}}{g_s}}} \qquad C_{v.linear} = 188.468$$

$$C_{v.ep} := \frac{q_{50}}{f_{ep}(0.5)\cdot\sqrt{\frac{\Delta P_{v.50}}{g_s}}} \qquad C_{v.ep} = 421.426$$

$$q_{lin}(l) := \sqrt{\frac{\left(C_{v.linear}\cdot f_{lin}(l)\right)^2\cdot\Delta P_T}{g_s + \left(C_{v.linear}\cdot f_{lin}(l)\right)^2\cdot c_q}}$$

$$q_{ep}(l) := \sqrt{\frac{\left(C_{v.ep}\cdot f_{ep}(l)\right)^2\cdot\Delta P_T}{g_s + \left(C_{v.ep}\cdot f_{ep}(l)\right)^2\cdot c_q}}$$



part b)

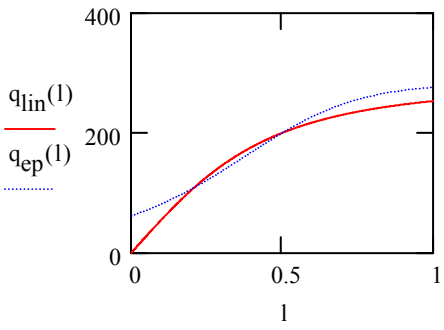
$\Delta P_{v.50} := 30 \qquad \Delta P_T := \Delta P_{v.50} + \Delta P_{cond.50} \qquad \Delta P_T = 60$

$$C_{v.linear} := \frac{q_{50}}{f_{lin}(0.5)\cdot\sqrt{\frac{\Delta P_{v.50}}{g_s}}} \qquad C_{v.linear} = 76.942$$

$$C_{v.ep} := \frac{q_{50}}{f_{ep}(0.5)\cdot\sqrt{\frac{\Delta P_{v.50}}{g_s}}} \qquad C_{v.ep} = 172.047$$

$$q_{lin}(l) := \sqrt{\frac{\left(C_{v.linear}\cdot f_{lin}(l)\right)^2\cdot\Delta P_T}{g_s + \left(C_{v.linear}\cdot f_{lin}(l)\right)^2\cdot c_q}}$$

$$q_{ep}(l) := \sqrt{\frac{\left(C_{v.ep}\cdot f_{ep}(l)\right)^2\cdot\Delta P_T}{g_s + \left(C_{v.ep}\cdot f_{ep}(l)\right)^2\cdot c_q}}$$



part c)

$\Delta P_{v.50} := 90 \qquad \Delta P_T := \Delta P_{v.50} + \Delta P_{cond.50} \qquad \Delta P_T = 120$

$$C_{v.linear} := \frac{q_{50}}{f_{lin}(0.5)\cdot\sqrt{\frac{\Delta P_{v.50}}{g_s}}} \qquad C_{v.linear} = 44.422$$

$$C_{v.ep} := \frac{q_{50}}{f_{ep}(0.5)\cdot\sqrt{\frac{\Delta P_{v.50}}{g_s}}} \qquad C_{v.ep} = 99.331$$

$$q_{lin}(l) := \sqrt{\frac{\left(C_{v.linear}\cdot f_{lin}(l)\right)^2\cdot\Delta P_T}{g_s + \left(C_{v.linear}\cdot f_{lin}(l)\right)^2\cdot c_q}}$$

$$q_{ep}(l) := \sqrt{\frac{\left(C_{v.ep}\cdot f_{ep}(l)\right)^2\cdot\Delta P_T}{g_s + \left(C_{v.ep}\cdot f_{ep}(l)\right)^2\cdot c_q}}$$