



UNIVERSITÀ
DEGLI STUDI
DI PADOVA



Dipartimento
di Ingegneria Industriale

Collaudo di una pompa

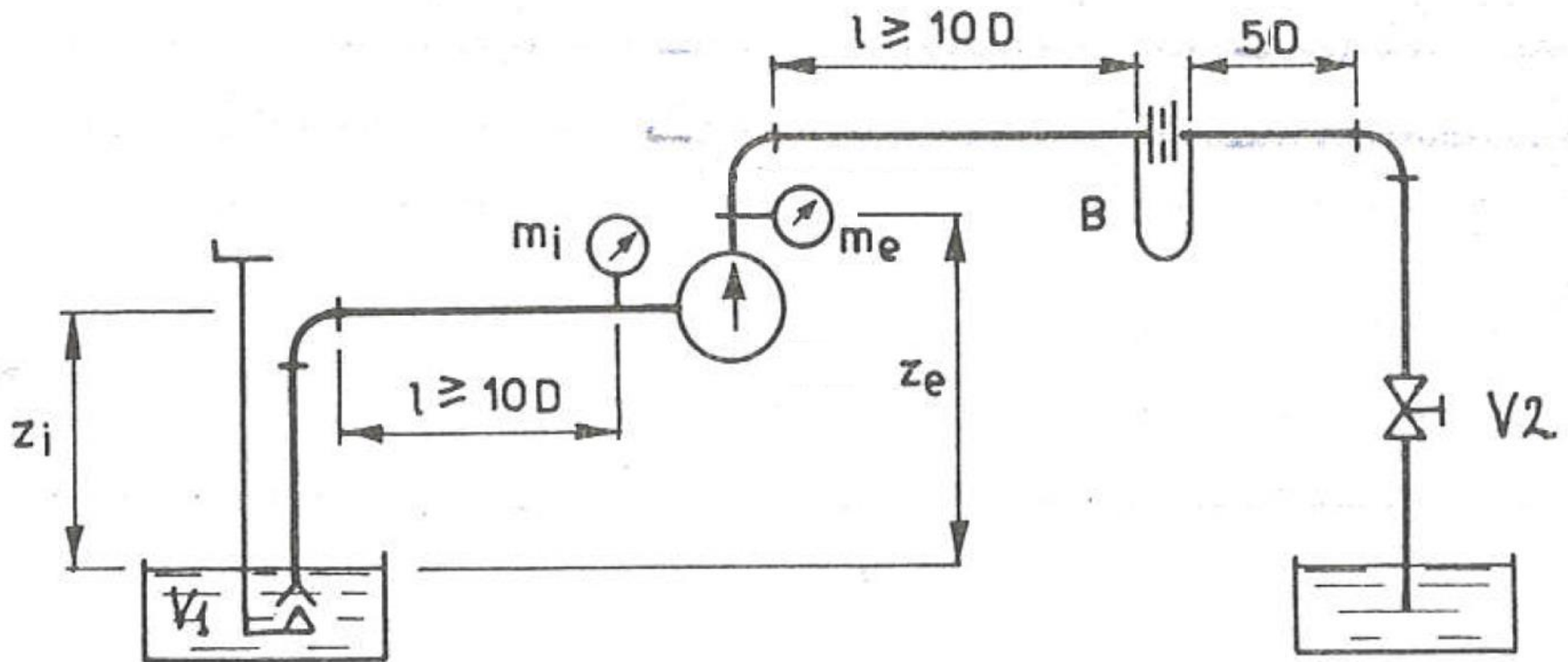
Corso di Macchine 1

Agenda

- ▶ Il circuito di collaudo
- ▶ Determinazione della prevalenza della macchina
 - ▶ Misuratori di pressione
 - ▶ Misuratore di portata
- ▶ Determinazione della coppia all'albero
- ▶ Le curve caratteristiche



Circuito di collaudo

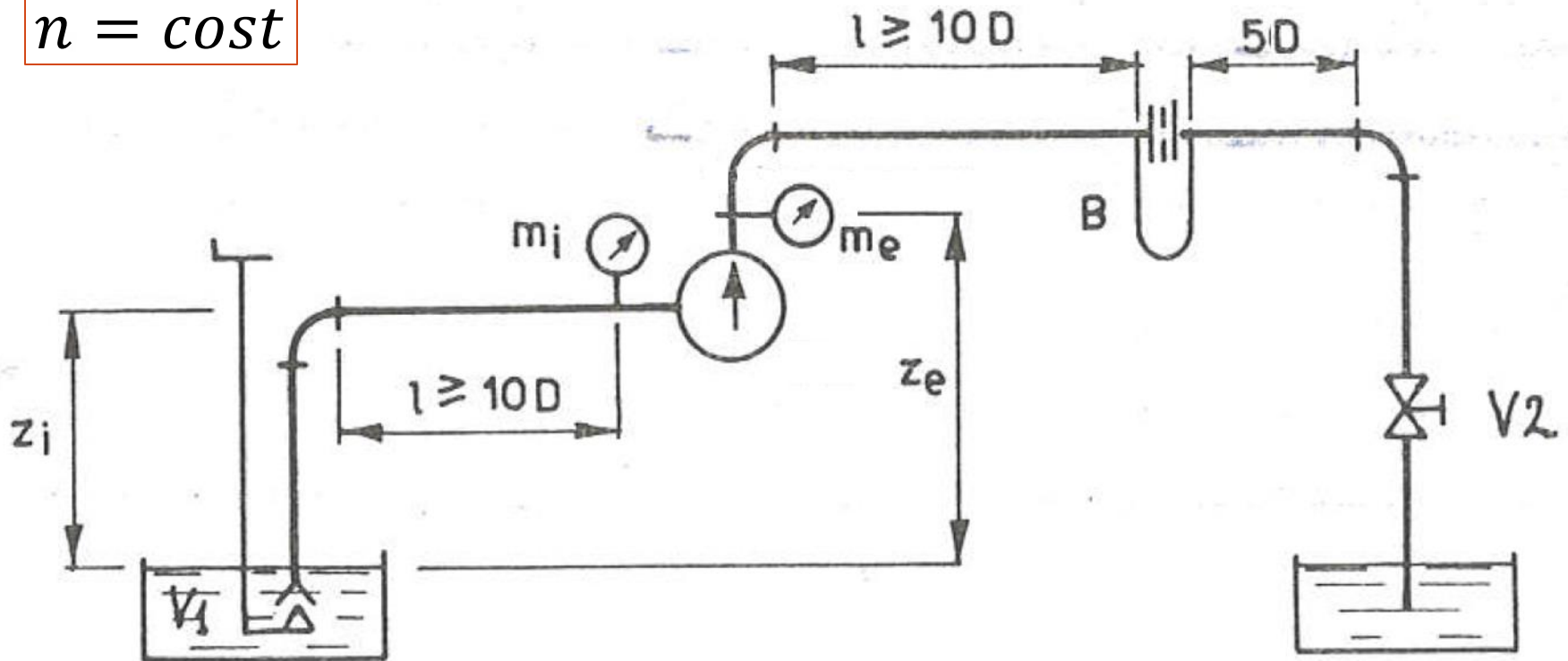


Circuito di collaudo



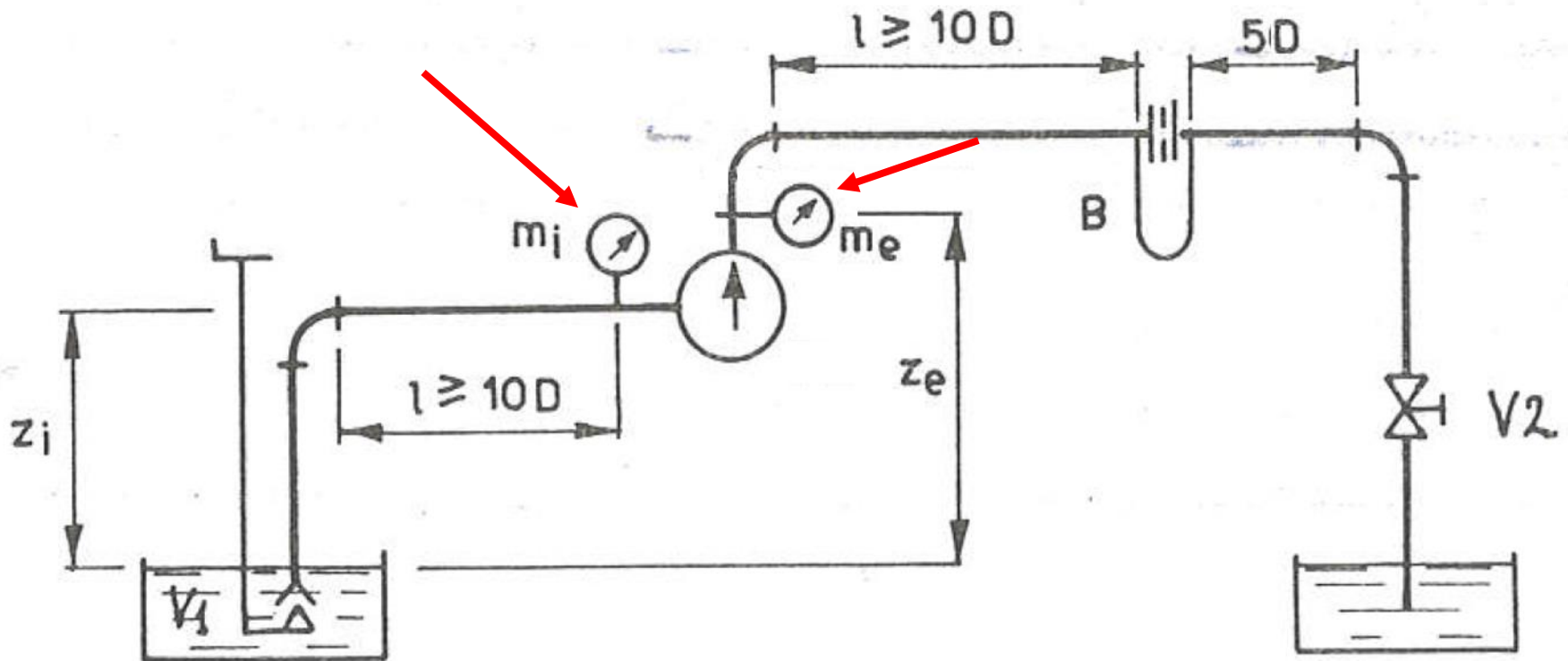
Determinazione della Prevalenza

$$n = \text{cost}$$



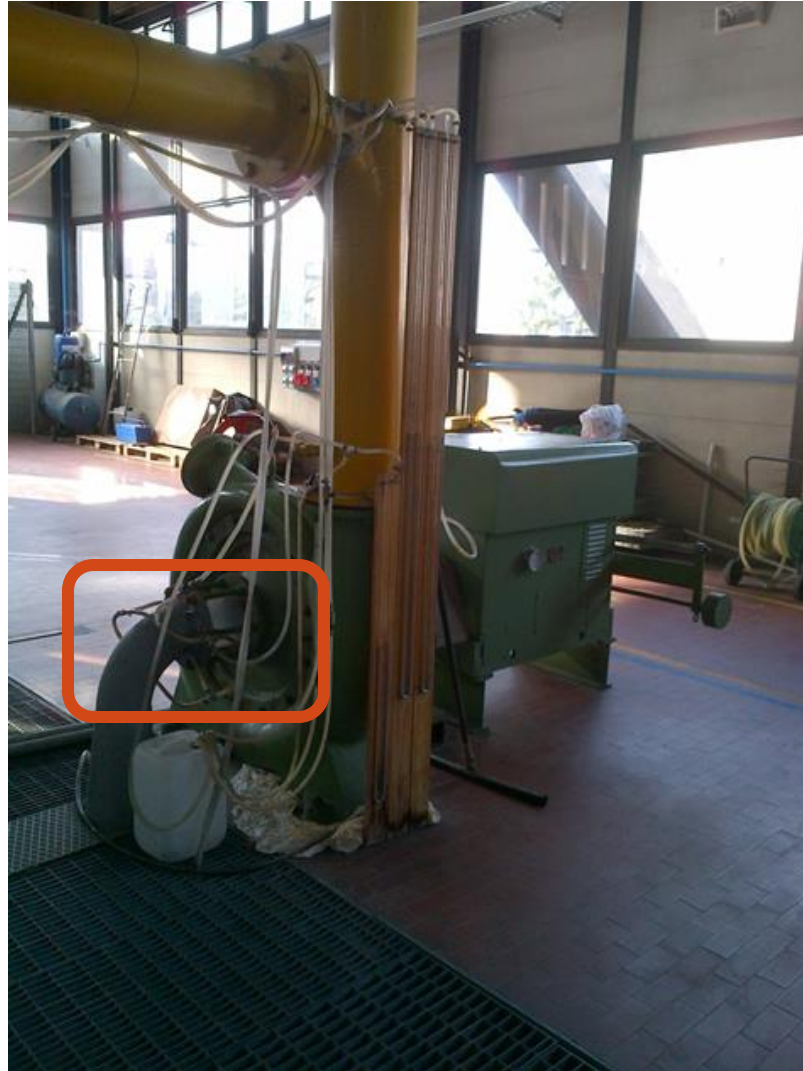
$$h = \frac{p_e - p_i}{\rho g} + \frac{c_e^2 - c_i^2}{2g} + (z_e - z_i) = f(Q)$$

Determinazione della Prevalenza



$$h = \frac{p_e - p_i}{\rho g} + \frac{c_e^2 - c_i^2}{2g} + (z_e - z_i) = f(Q)$$

Determinazione della Prevalenza



Determinazione della Prevalenza

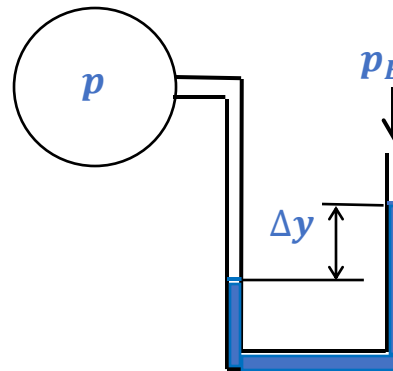


Misuratori di pressione

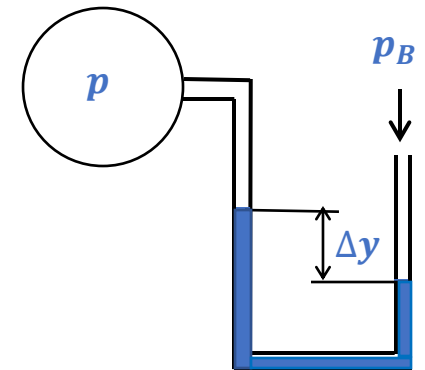
- Z e Z_{0m} si leggono all'inizio delle prove, a macchina ferma, e rimangono inalterati in seguito, durante le prove.

$$p + \rho g (Z - Z_{0m}) + \rho g \frac{\Delta y}{2} = p_B + \rho_m g \Delta y$$

$$\frac{p - p_B}{\rho g} = \frac{p_{rel}}{\rho g} = \Delta y \left(\frac{\rho_m}{\rho} - 0,5 \right) - (Z - Z_{0m})$$



$$\Delta y > 0 \Rightarrow p > p_B$$



$$\Delta y < 0 \Rightarrow p < p_B$$

Misuratori di pressione



Δz_b = Differenza tra i due menischi all'aspirazione



$\Delta z_b \rightarrow$ Depressione $\rightarrow$ Segno (-)

Misuratori di pressione

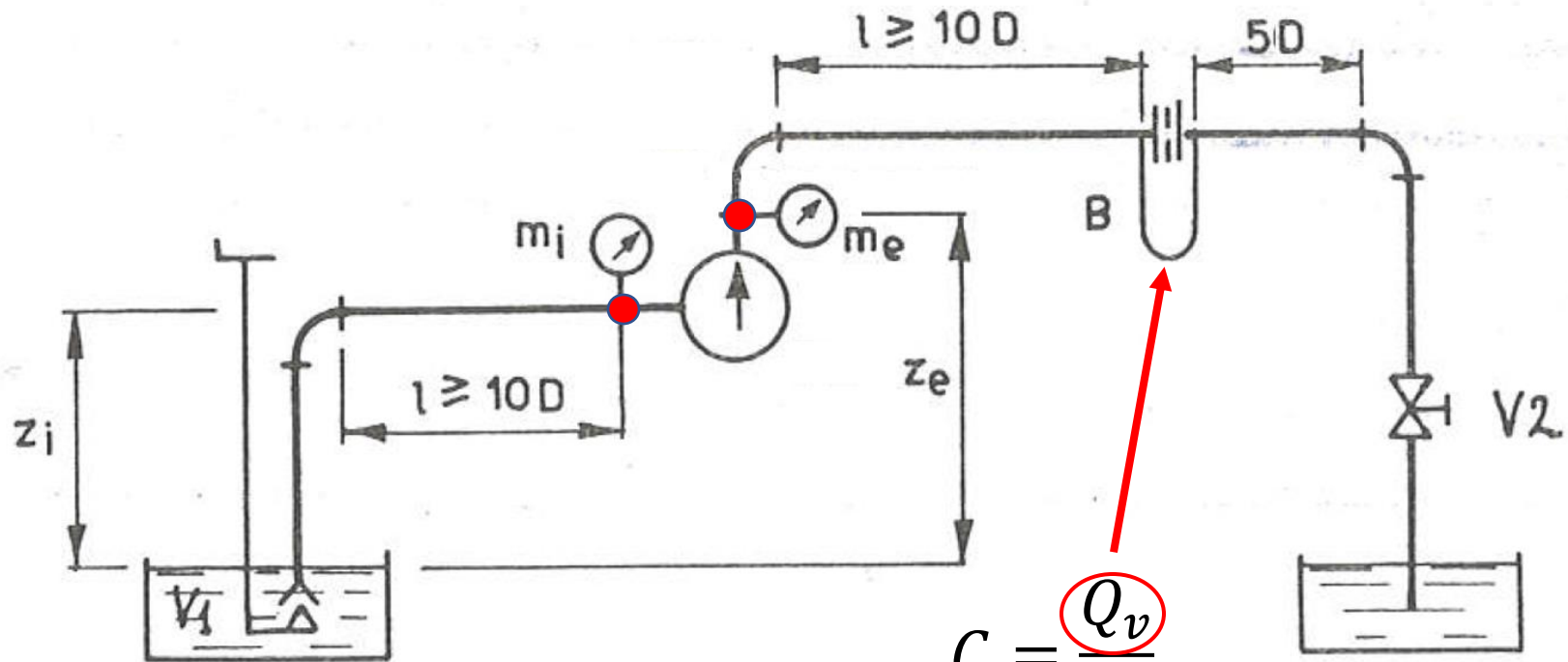


Δz_a = Differenza tra i due menischi alla mandata



$\Delta z_a \rightarrow$ Sovrappressione $\rightarrow$ Segno (+)

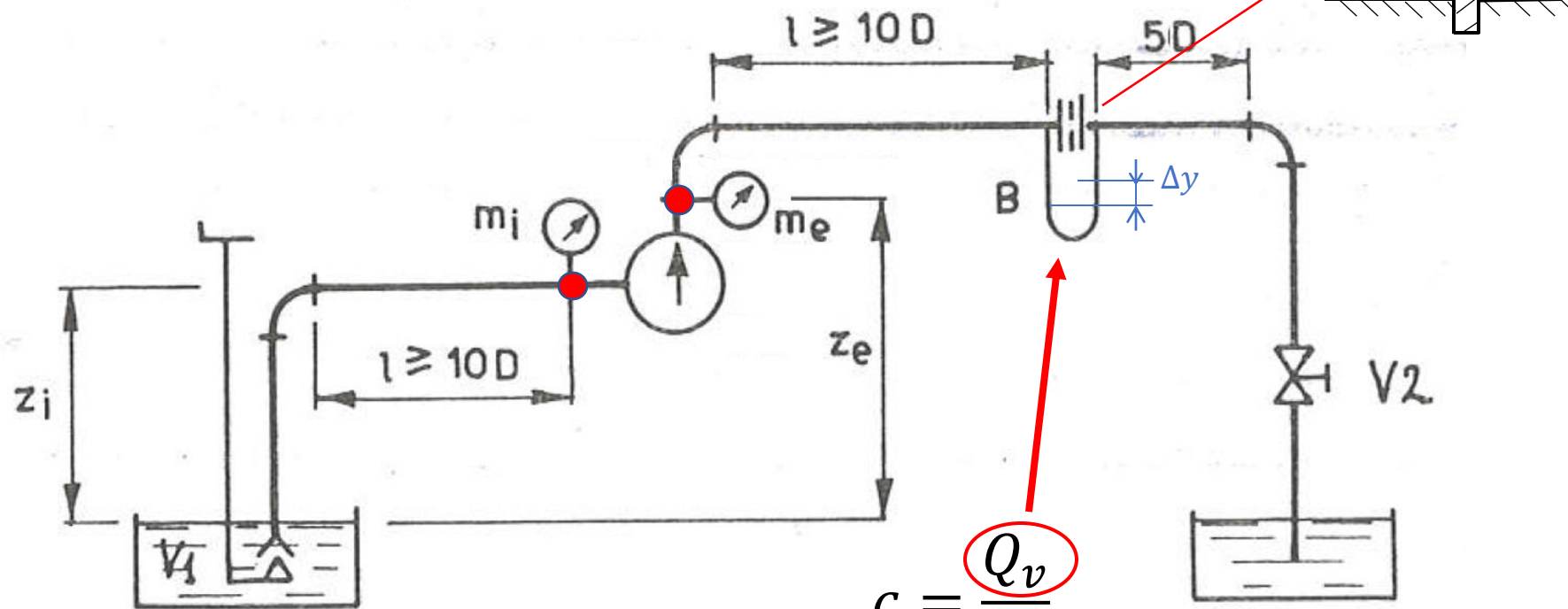
Determinazione della Prevalenza



$$h = \frac{p_e - p_i}{\rho g} + \frac{C_e^2 - C_i^2}{2g} + (z_e - z_i) = f(Q)$$

A red circle highlights the term $\frac{C_e^2 - C_i^2}{2g}$ in the equation, with a red arrow pointing to it from the equation $C = \frac{Q_v}{A}$ above.

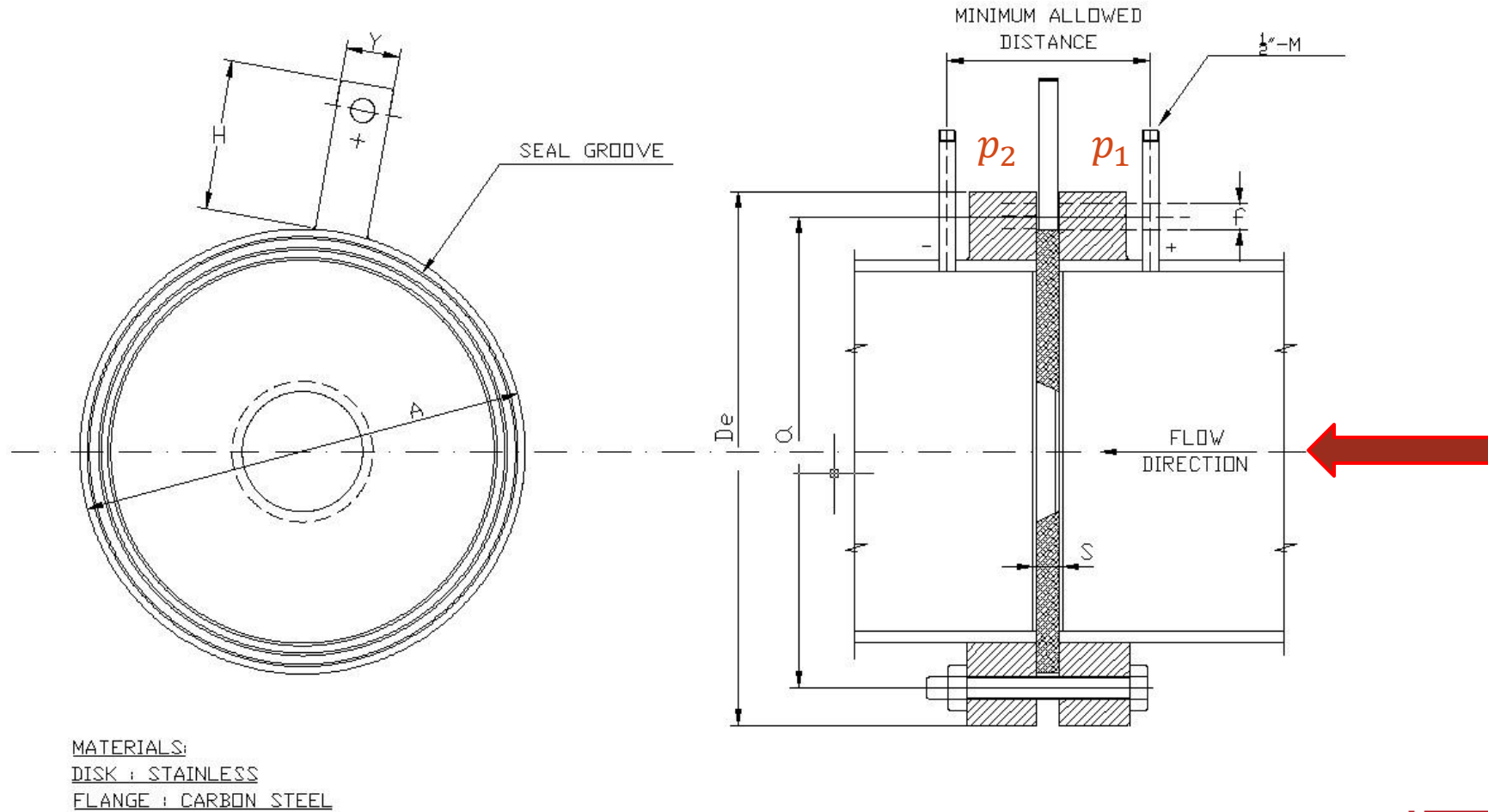
Determinazione della Prevalenza



$$h = \frac{p_e - p_i}{\rho g} + \frac{c_e^2 - c_i^2}{2g} + (z_e - z_i) = f(Q)$$

$c = \frac{Q_v}{A}$

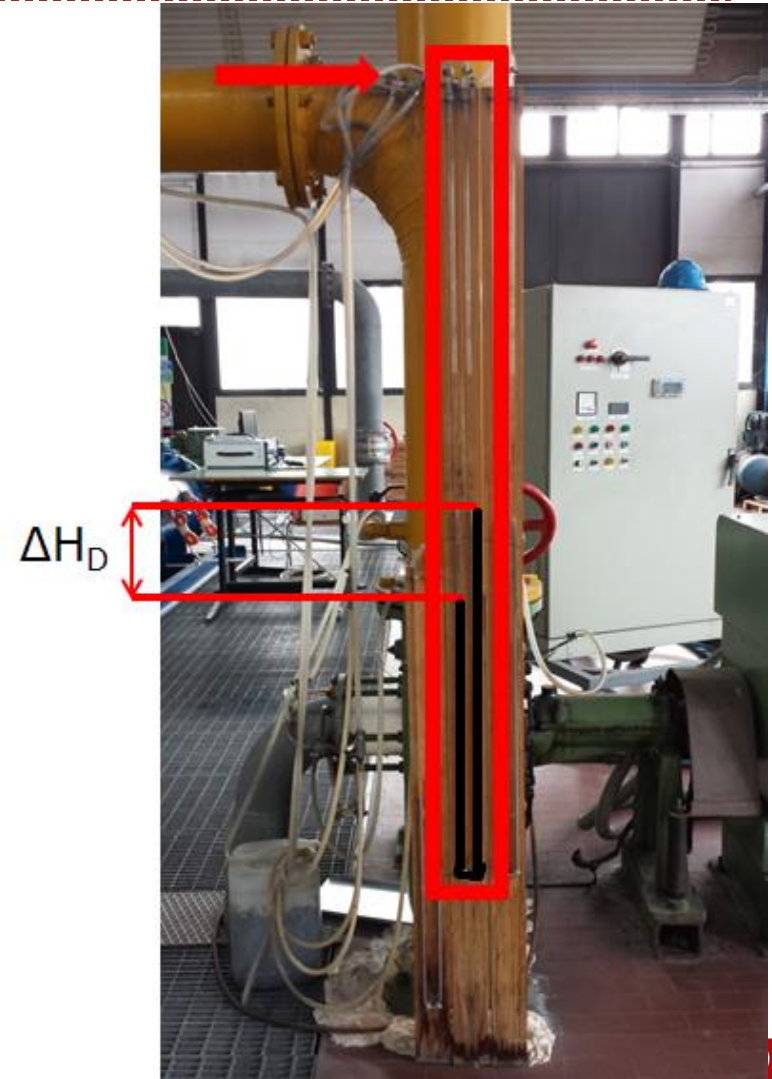
Misuratore di portata



Misuratore di portata

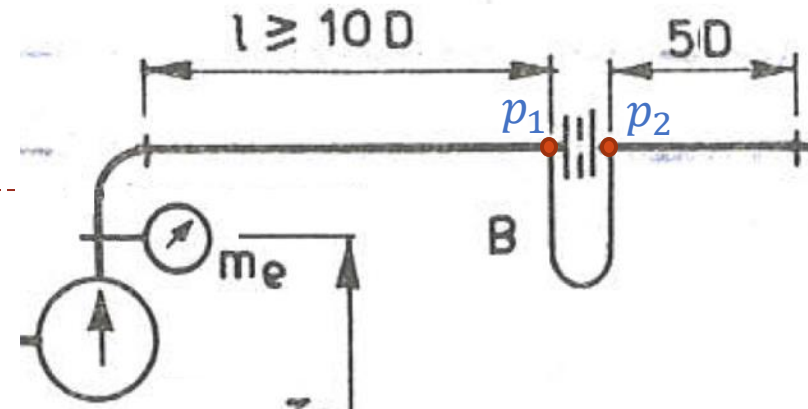
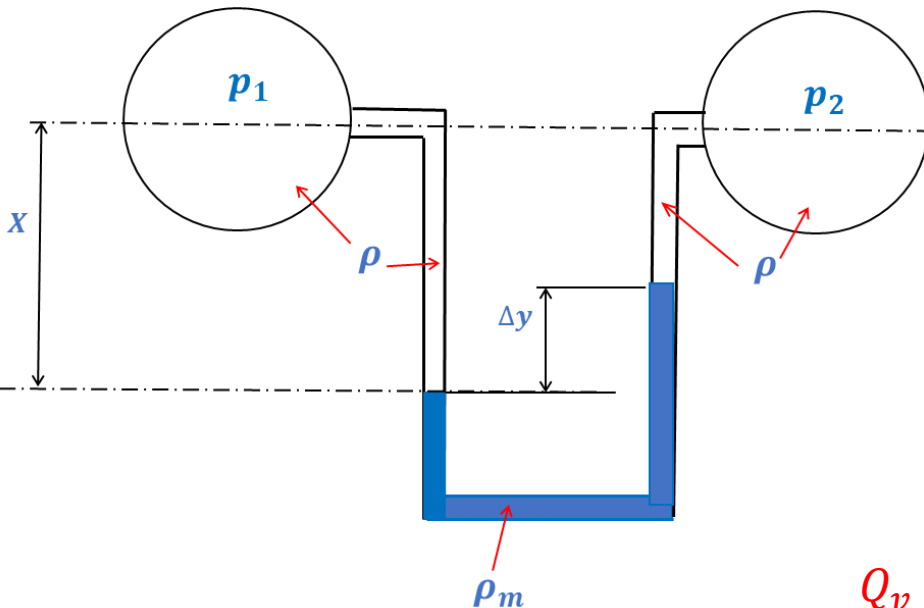


Misuratore di portata



Misuratore di portata

$$h = \frac{p_e - p_i}{\rho g} + \frac{c_e^2 - c_i^2}{2g} + (z_e - z_i) = f(Q)$$



$$p_1 + \rho g X = p_2 + \rho g (X - \Delta y) + \rho_m g \Delta y$$

$$\frac{\Delta p}{\rho} = \frac{p_1 - p_2}{\rho} = g \Delta y \left(\frac{\rho_m}{\rho} - 1 \right)$$

$$Q_v = \alpha \pi \frac{d^2}{4} \sqrt{2 \frac{\Delta p}{\rho}} = \alpha \pi \frac{d^2}{4} \sqrt{2 g \Delta y \left(\frac{\rho_m}{\rho} - 1 \right)}$$

$$C_{i,e} = \frac{4 Q_v}{\pi D_{i,e}^2}$$

Misuratore di portata

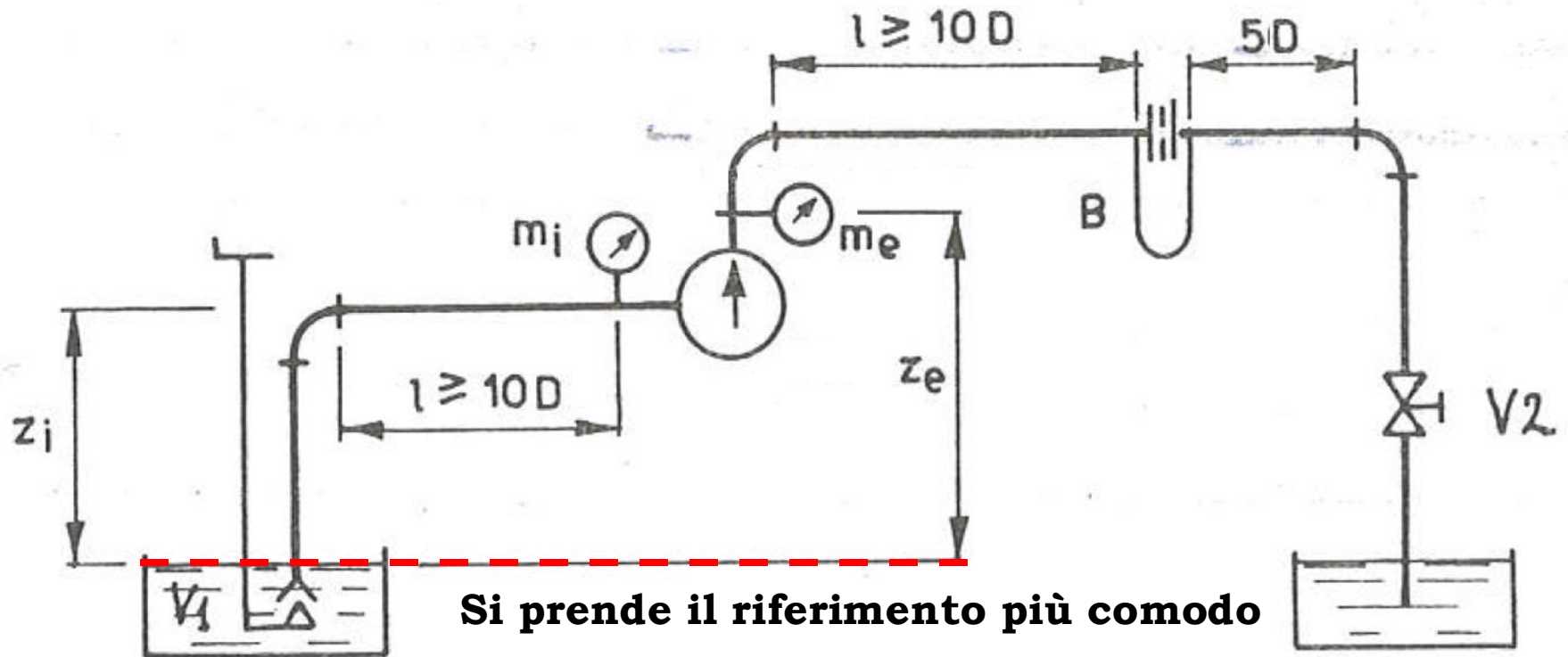
Specifiche Diaframmi		
k	$3.8944 \cdot 10^{-7}$	
α	0.677	
d	135	mm



↓

$$Q_v [m^3 / s] = k \cdot \alpha \cdot d_{[mm]}^2 \sqrt{\Delta H_{D[mm]}}$$

Determinazione della Prevalenza

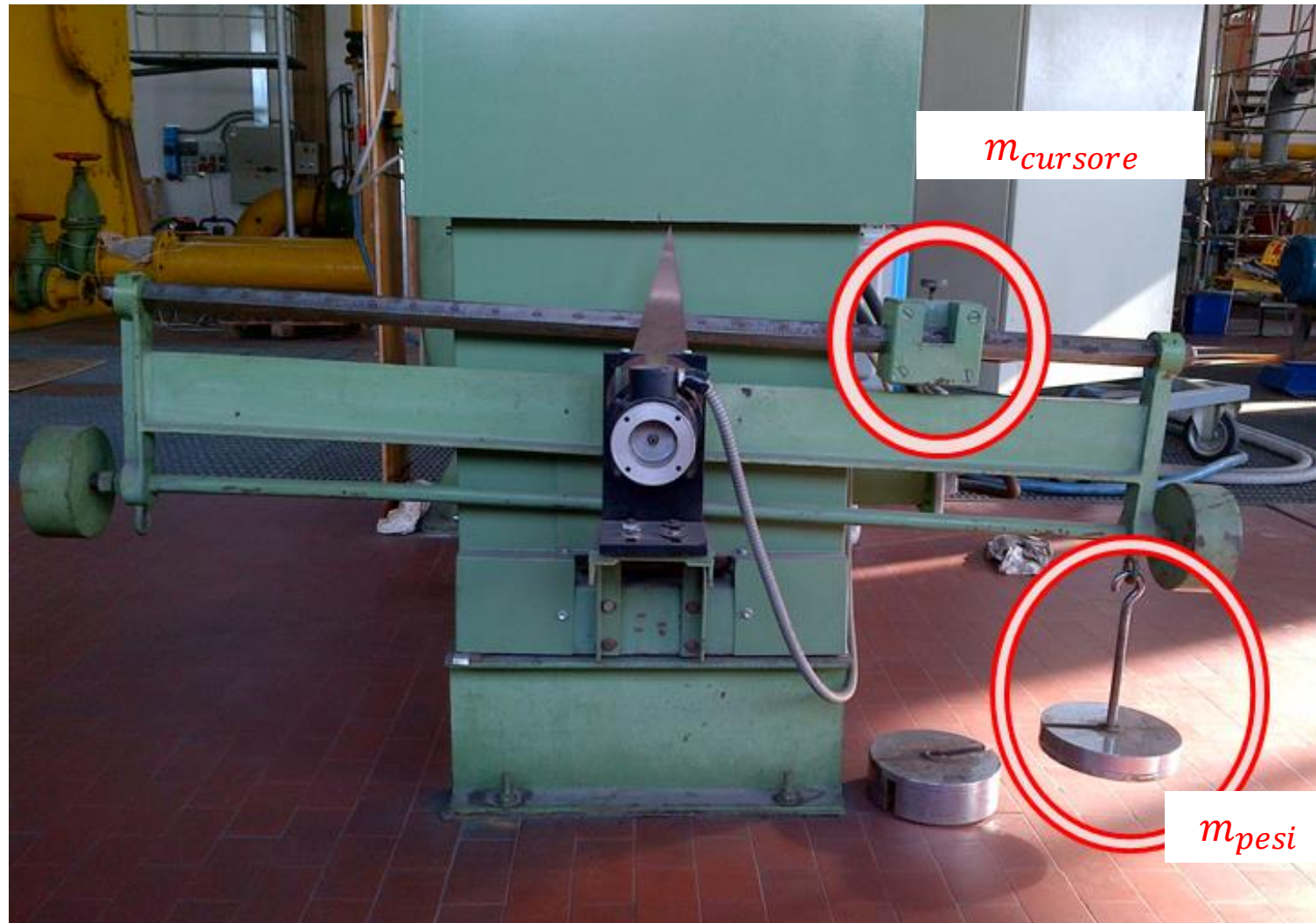


$$h = \frac{p_e - p_i}{\rho g} + \frac{c_e^2 - c_i^2}{2g} + (z_e - z_i) = f(Q)$$

La coppia all'albero



La coppia all'albero



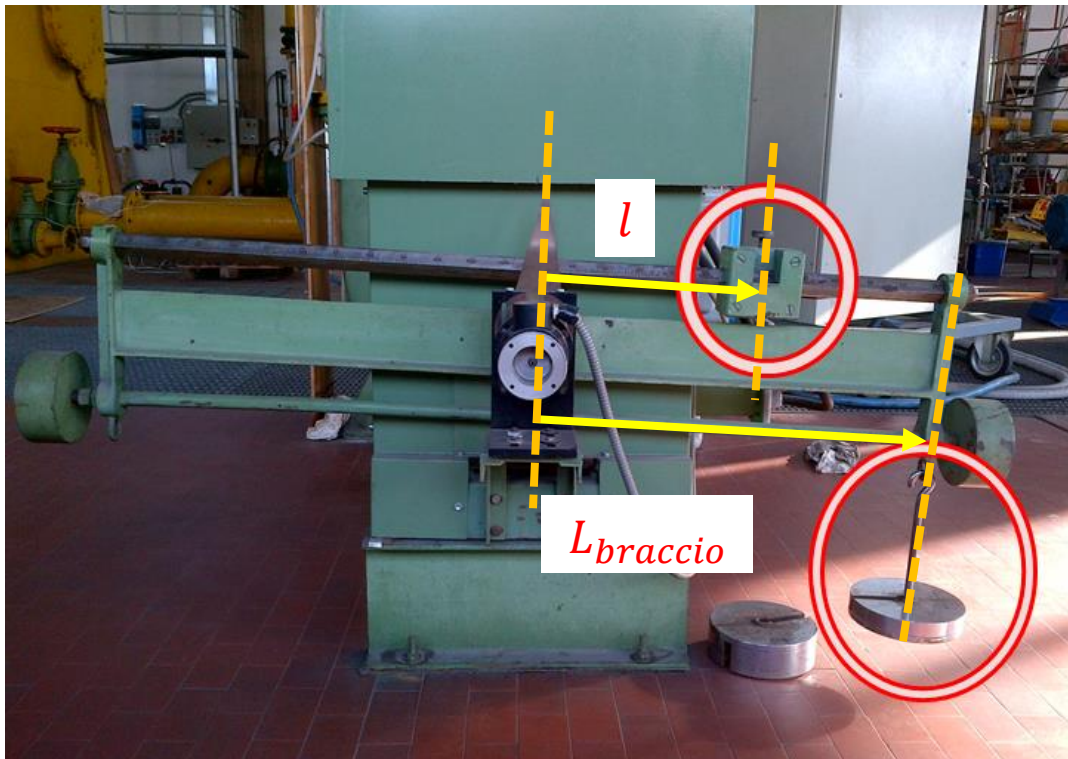
La coppia all'albero

$$M_{alb} = m_{cursore} \cdot l \pm \sum m_{pesi} \cdot L_{braccio}$$

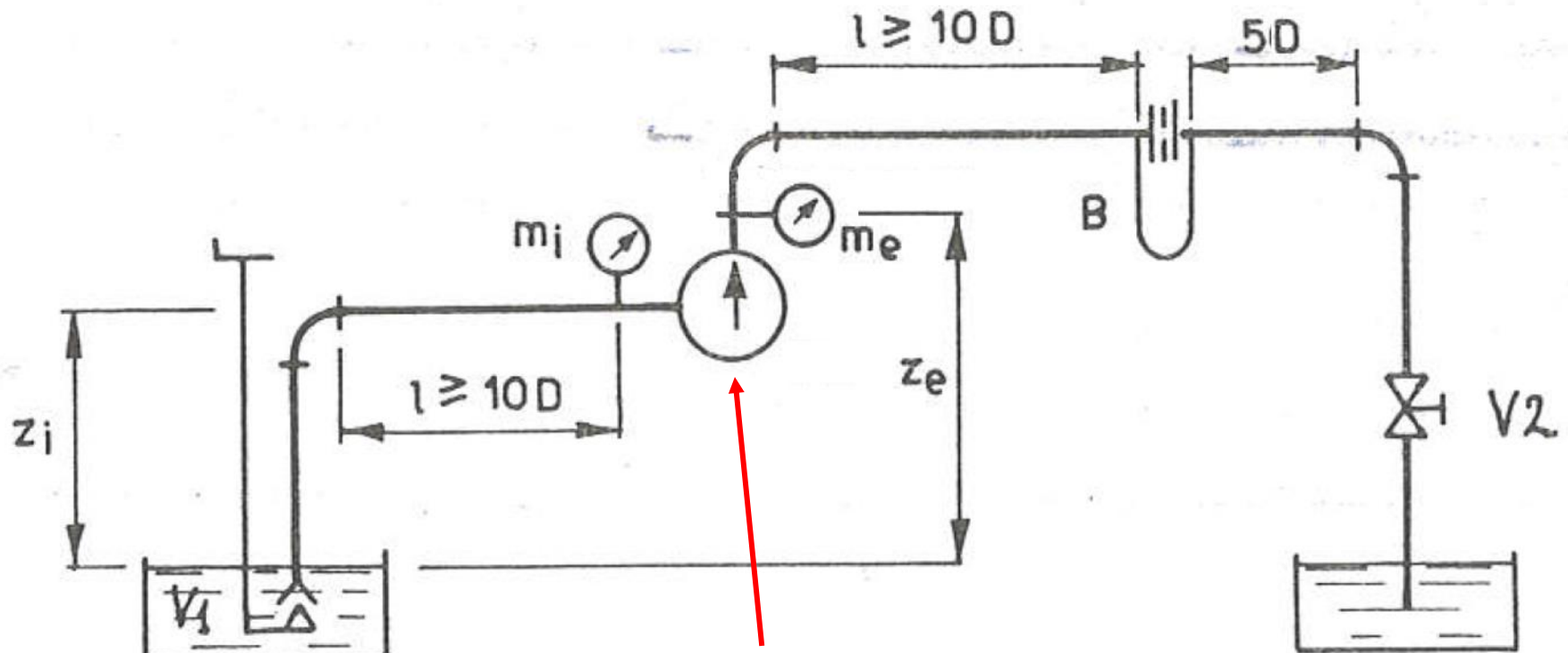
$$m_{cursore} = 4.868 \text{ kg}$$

$$L_{braccio} = 635 \text{ mm}$$

Attenzione ai segni dei momenti!!



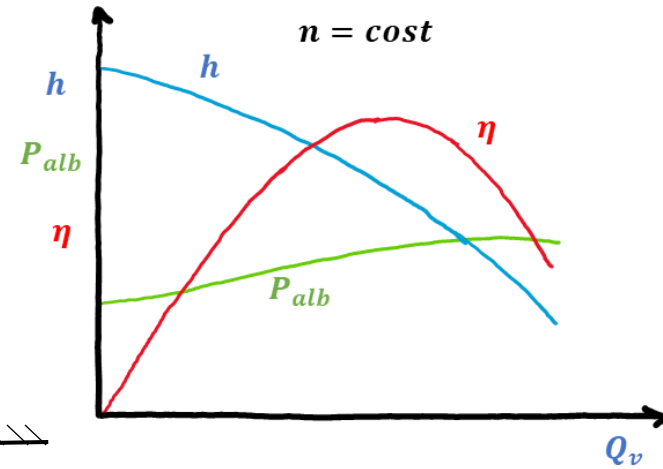
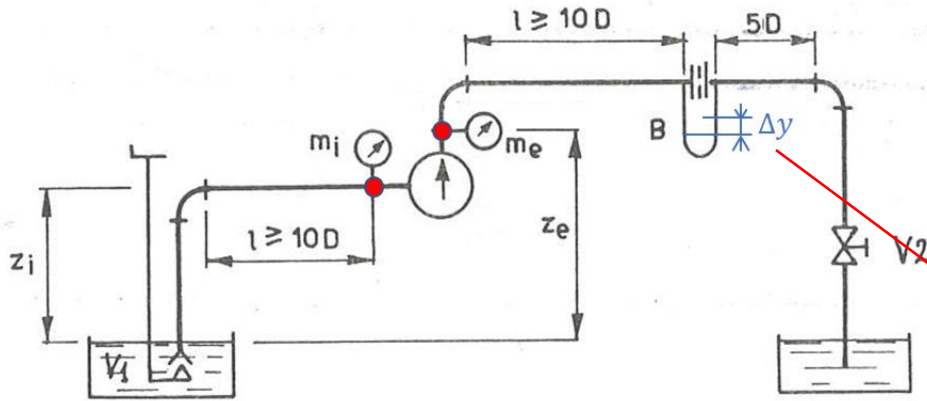
La potenza all'albero



$$P_{alb} = M_{alb} \cdot \omega$$

$$\eta = \frac{\rho Q_v g h}{P_{alb}}$$

Collaudo di una pompa

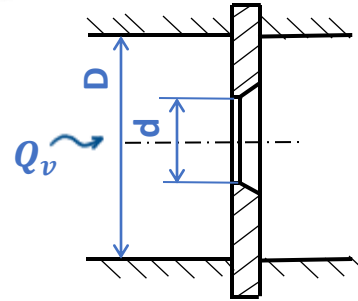


$$h = \frac{p_e - p_i}{\rho} + \frac{C_e^2 - C_i^2}{2} + (Z_e - Z_i)$$

$$Q_v = \alpha \pi \frac{d^2}{4} \sqrt{2 \frac{\Delta p}{\rho}} = \alpha \pi \frac{d^2}{4} \sqrt{2 g \Delta y \left(\frac{\rho_m}{\rho} - 1 \right)}$$

$$\alpha = f \left(R_e, \frac{d}{D} \right) \quad \text{coefficiente di portata}$$

$$C_i = \frac{Q_v}{\pi D_i^2 / 4} \quad C_e = \frac{Q_v}{\pi D_e^2 / 4}$$



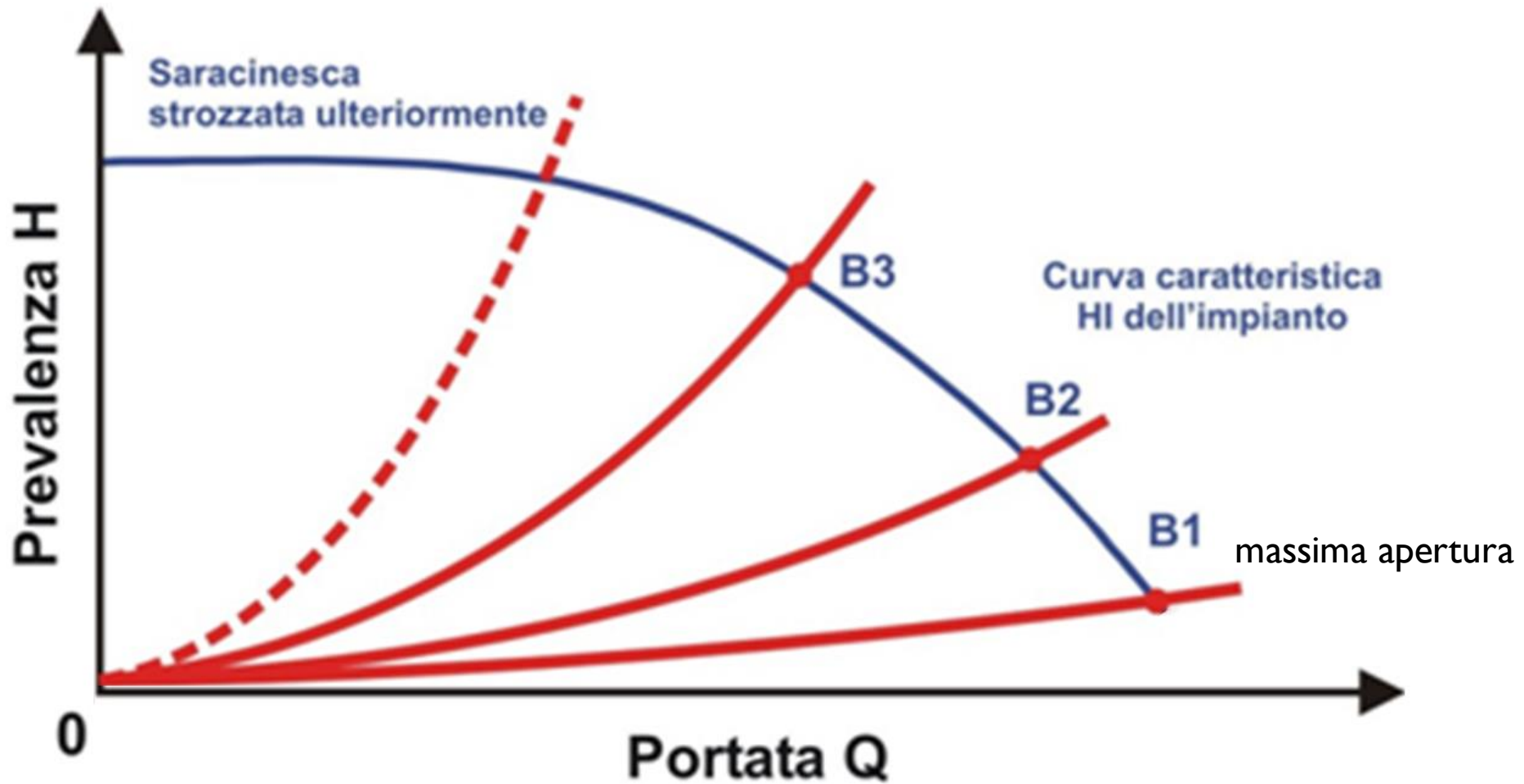
$$P_{alb} = M_{alb} \omega$$

M_{alb} : torsionmeter, dynamometric machine

$$\eta = \frac{\rho Q_v g h}{P_{alb}}$$



Caratteristiche funzionali



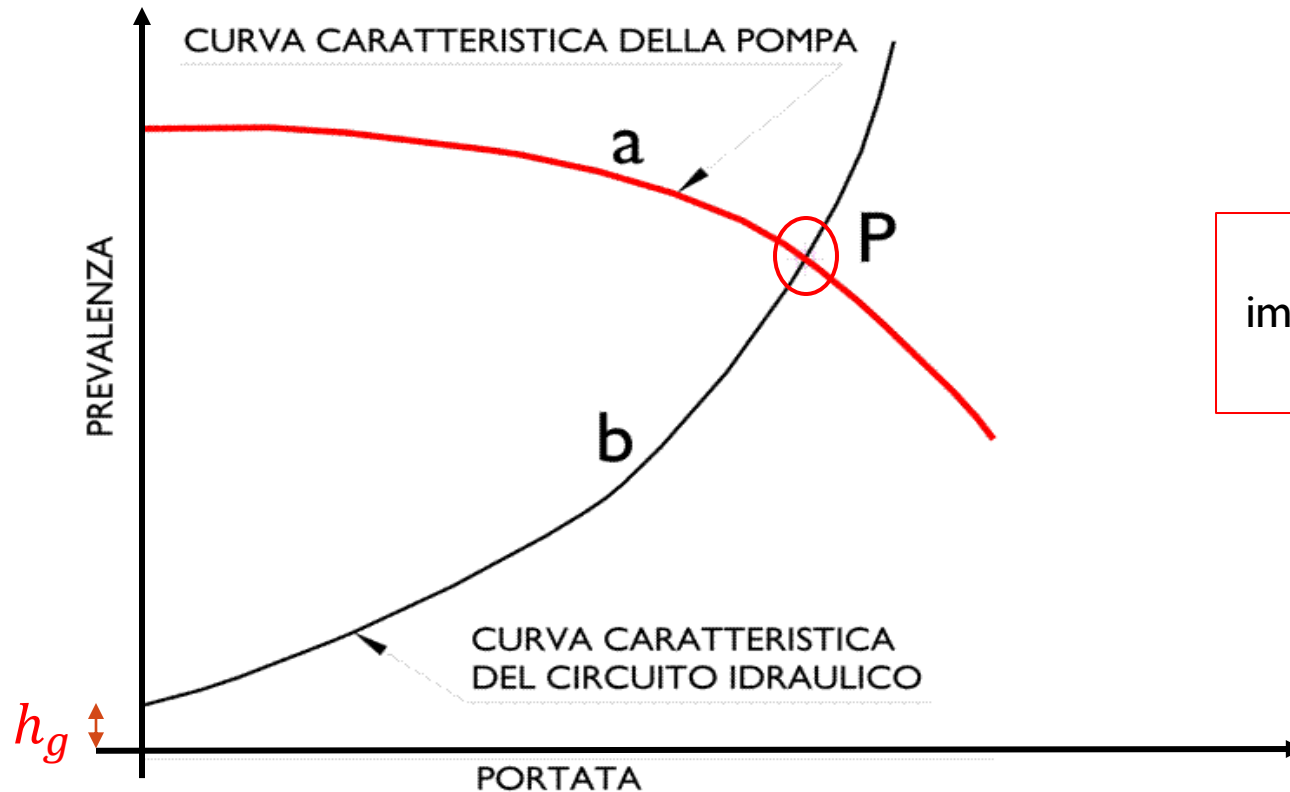
La valvola



La valvola



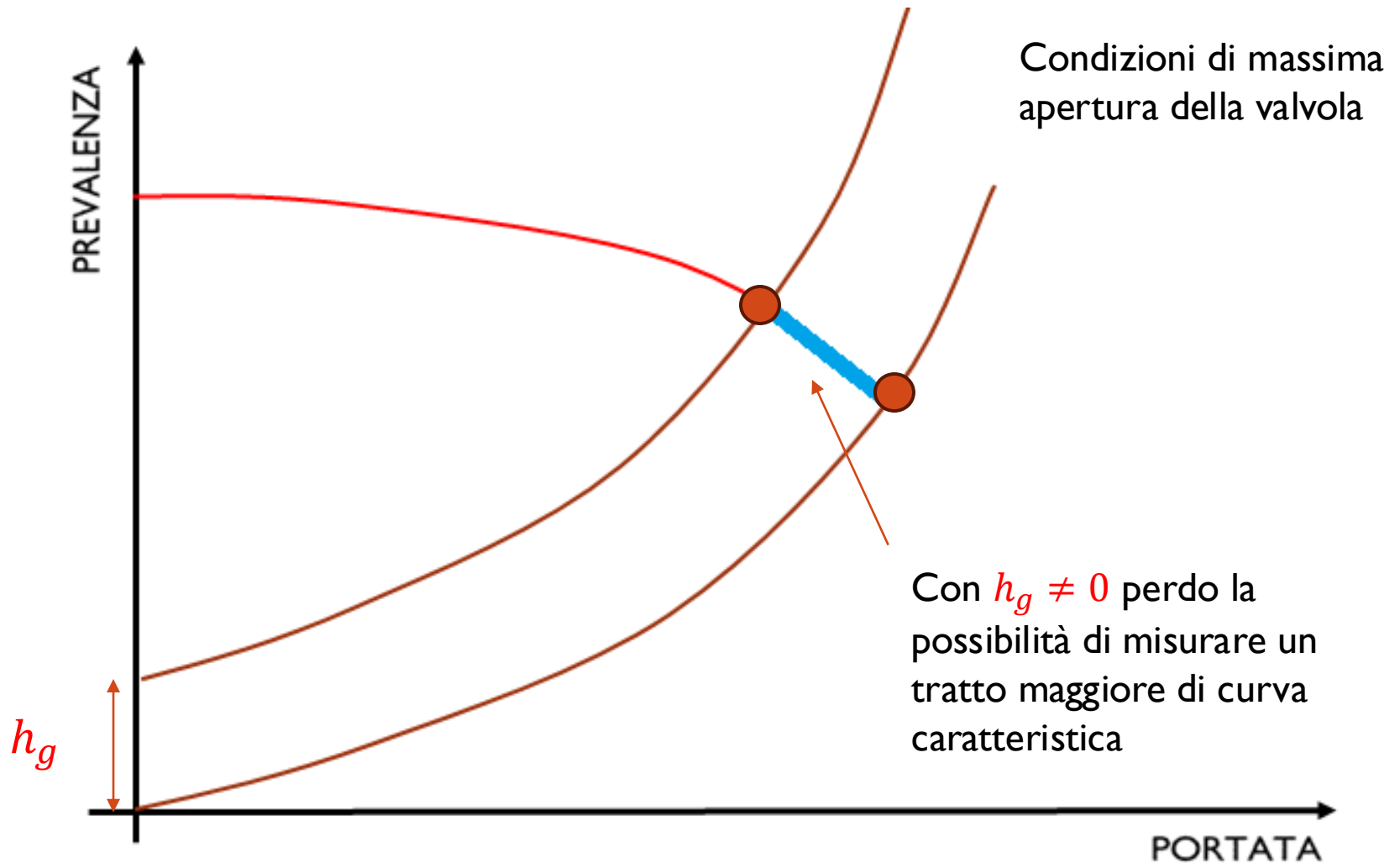
Curve caratteristiche



Perché negli
impianti di collaudo
 $h_g = 0??$

$$h_r = h_g \pm \left(0.5 \frac{c^2}{2g} + \sum K \frac{c^2}{2g} + \sum f \frac{l}{D} \frac{c^2}{2g} + \frac{c^2}{2g} \right)$$

Curve caratteristiche

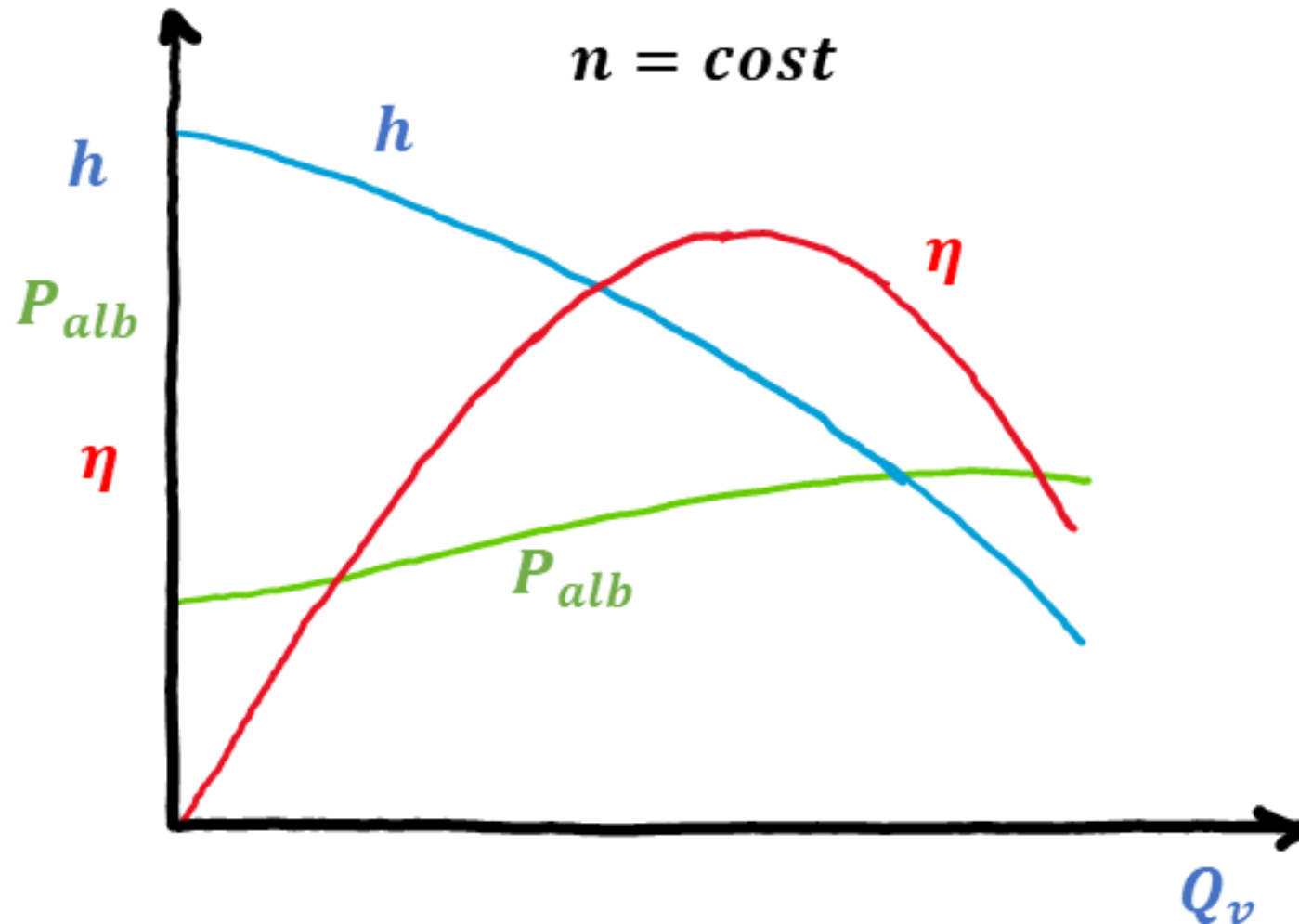


La tabella delle misure

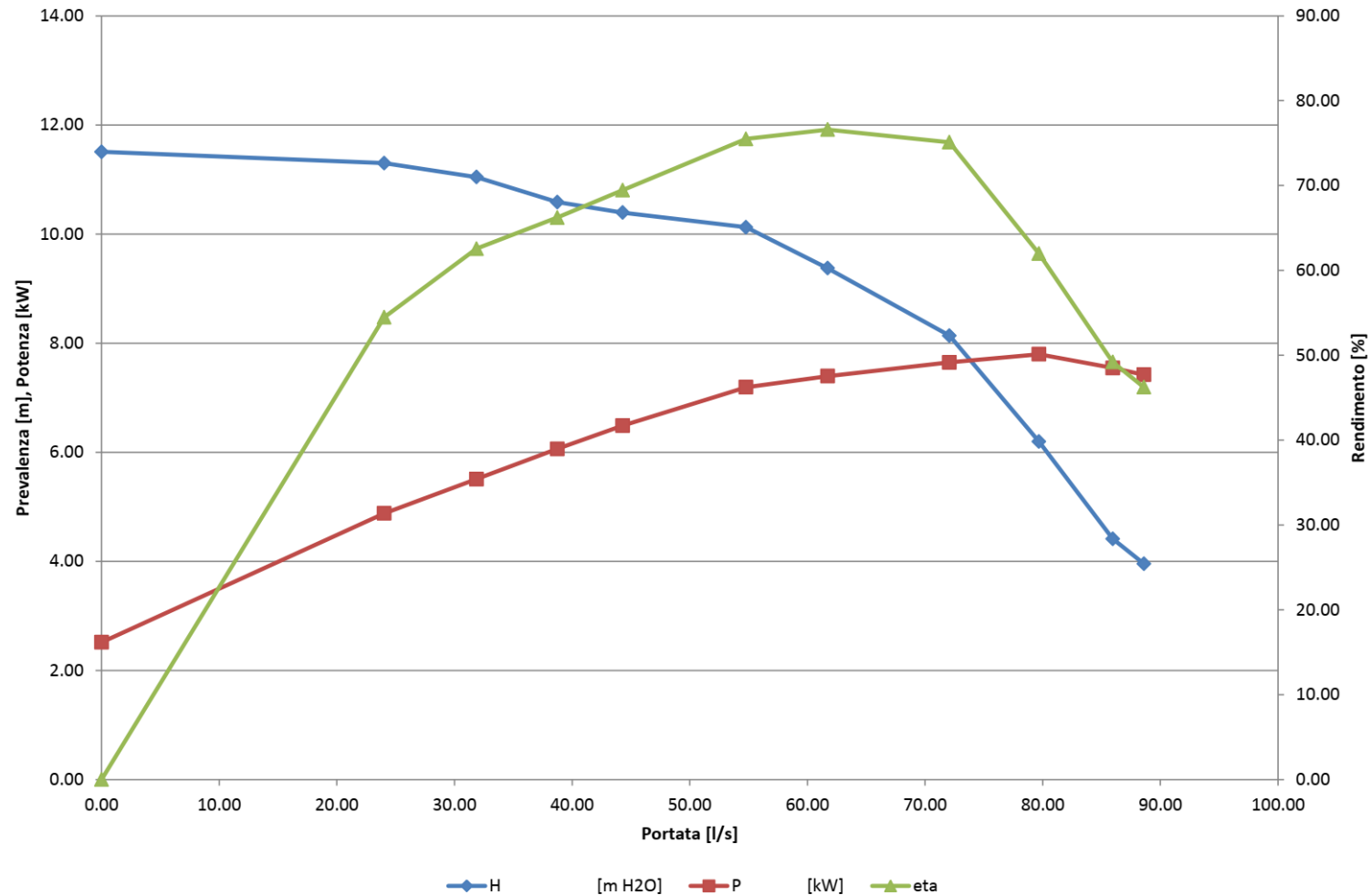
Misure Sperimentali:

Δz_a [mm]	Δz_b [mm]	ΔH_D [mm]	l [mm]	M_{Agg} [kg]

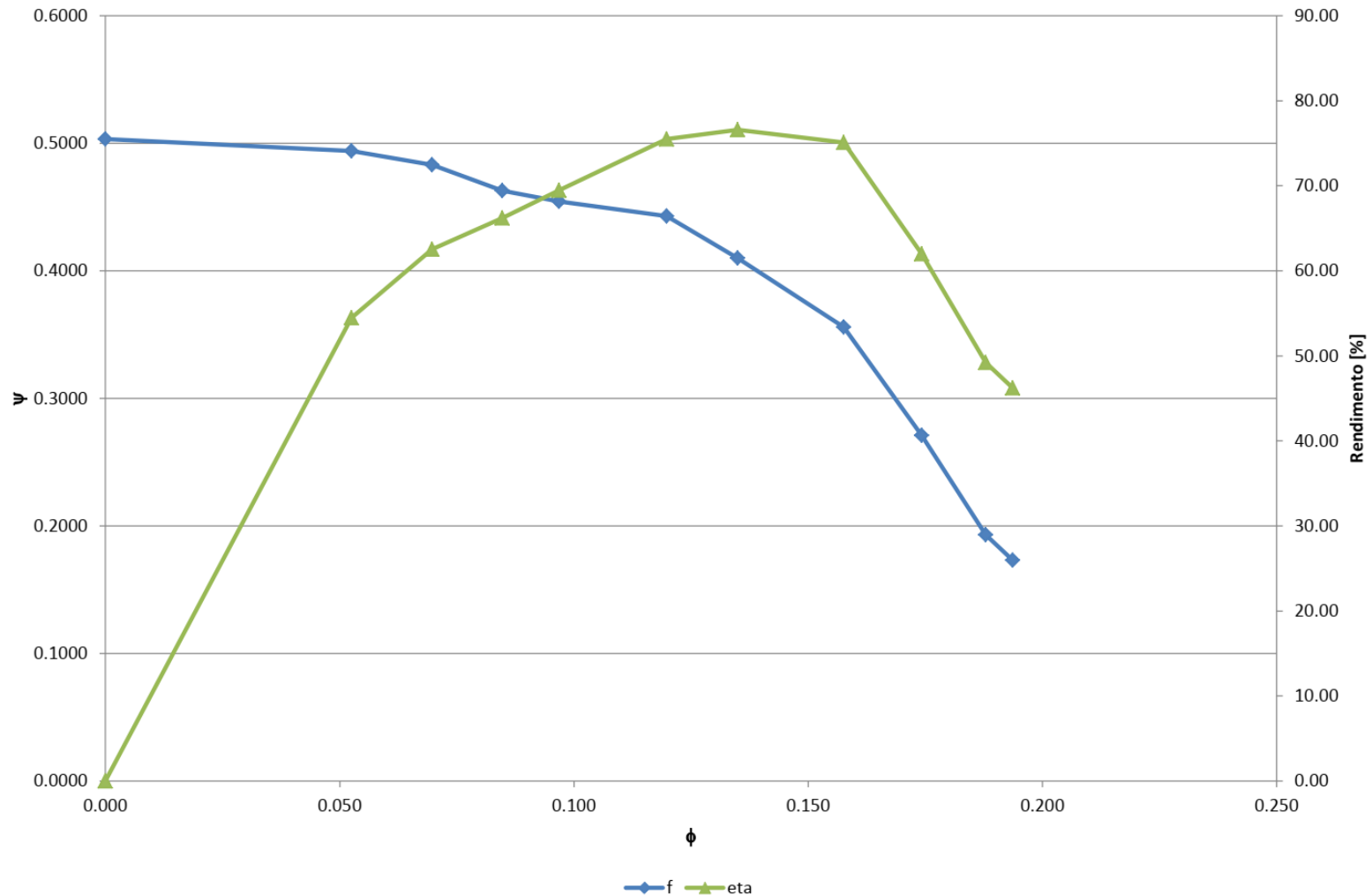
Curve caratteristiche



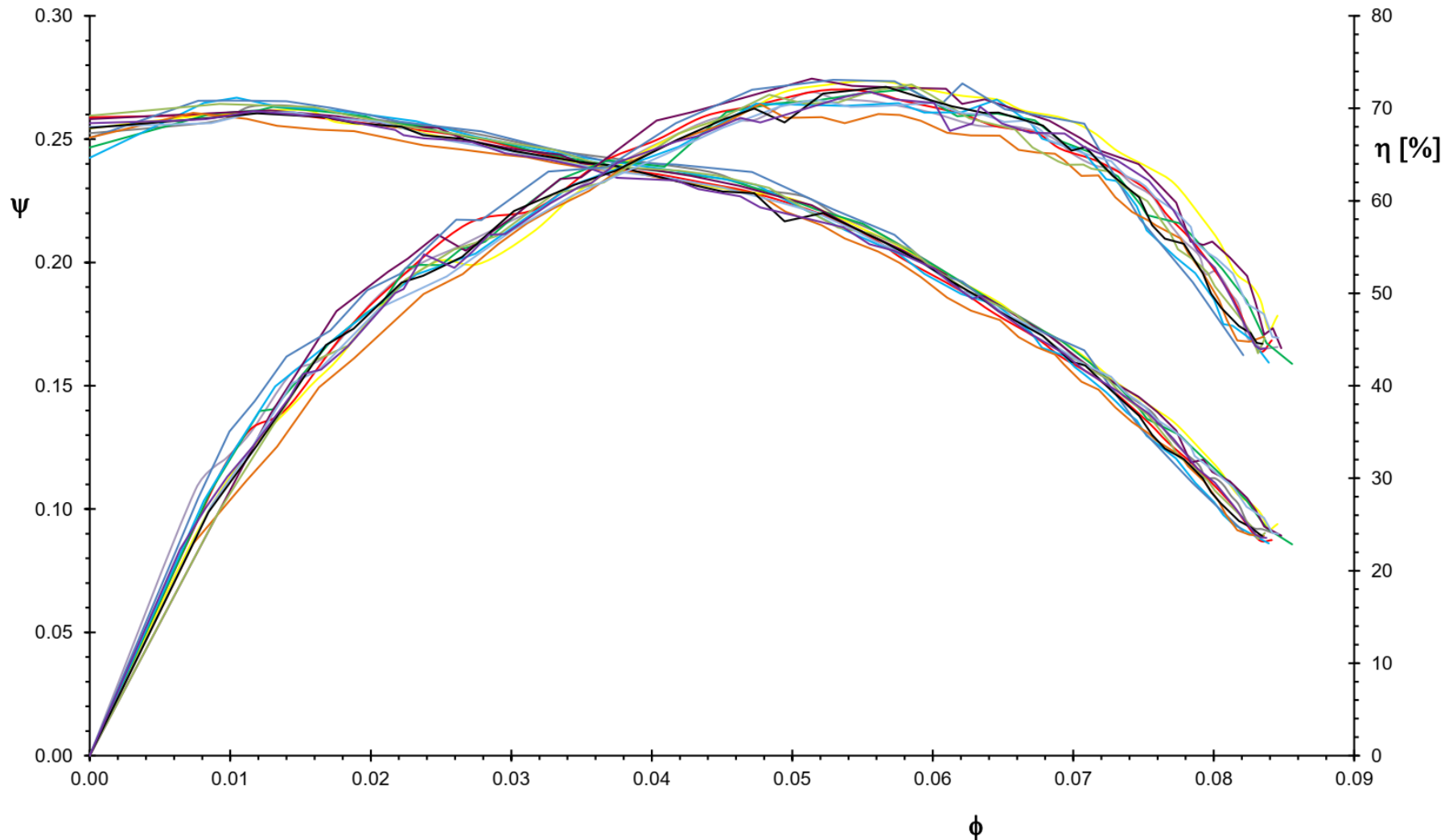
Il risultato della prova



Il risultato della prova



Il risultato della prova



Domande, Curiosità, Dubbi, Perplessità?

