

ICATT	APPRENTICESHIP PROGRAM TRAIN.RETAIN.GROW.	Information
Date:	Calculation of piston force and piston speed - pneumatics	

A double acting cylinder 80/25 x 160 with an efficiency factor 0.8 is used for a machine in the packaging industry. The operating pressure is 8 bar/

- A) Calculate the extending and retracting piston force
- B) Calculate the extending and retracting piston speed at a volume flow rate of 30 L/min

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Given:

Double acting cylinder

80mm \varnothing of piston25mm \varnothing of piston rod

160 mm length of piston stroke

Efficiency $\eta = 0.8$

Operating pressure 8 bar

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A)

ISO:

Force F1 ext in N

Force F2 ret in N

B)

ISO:

Piston Speed V1 ext in m/min

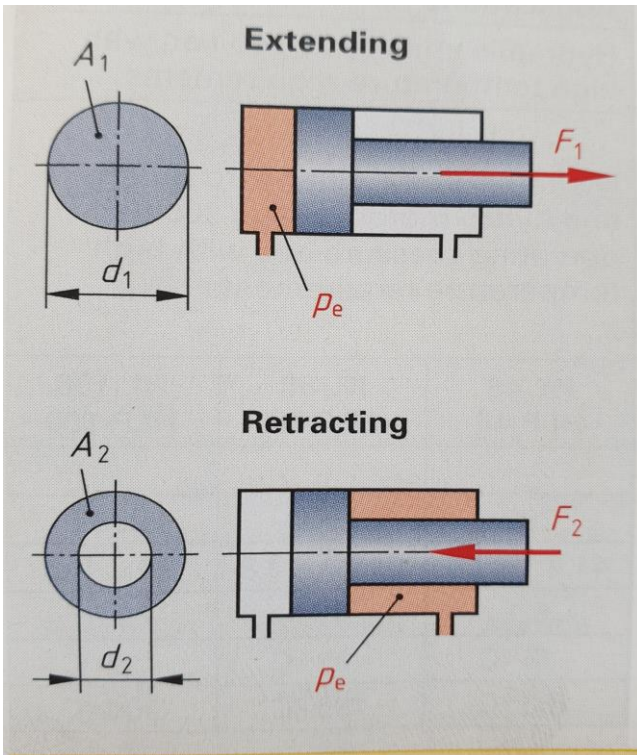
Piston Speed V2 ret in m/min

at a volume flow rate of 30 L/min

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Solution A)



Note

$$1 \text{ bar} = 10 \text{ N/cm}^2 \\ = 0,1 \text{ N/mm}^2$$

$$F = p_e * A * \eta$$

Calculate areas front and back of piston (A1 and A2)

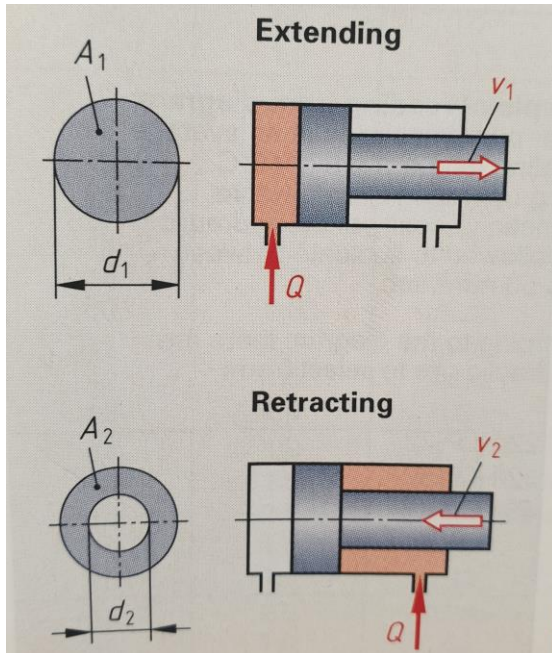
$$\begin{aligned} F_{1 \text{ ext}} &= p_e * A_1 * \eta \\ &= p_e * ((D^2 * \pi) / 4) * \eta \\ &= 8 \text{ bar} * ((80^2 \text{ mm} * \pi) / 4) * 0,8 \\ &= 8 \text{ N/mm}^2 * ((80^2 \text{ mm} * \pi) / 4) * 0,8 \\ &= \mathbf{3216,99 \text{ N}} \end{aligned}$$

$$\begin{aligned} F_{2 \text{ ret}} &= p_e * A_2 * \eta \\ &= p_e * (((D^2 - d^2) * \pi) / 4) * \eta \\ &= 8 \text{ bar} * (((80^2 \text{ mm} - 25^2 \text{ mm}) * \pi) / 4) * 0,8 \\ &= 8 \text{ N/mm}^2 * (((80^2 \text{ mm} - 25^2 \text{ mm}) * \pi) / 4) * 0,8 \\ &= \mathbf{2902,83 \text{ N}} \end{aligned}$$

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Solution B)



Note

1 mm = 0,1 cm = 0,01 dm
= 0,001m

$$Q = 30 \text{ L/min} = 30 \text{ dm}^3 = 0,030 \text{ m}^3/\text{min}$$

$$V1 \text{ ext} = Q/A1$$

$$= Q / ((D^2 * \pi) / 4)$$

$$= 0,030 \text{ m}^3/\text{min} / ((80^2 \text{ mm} * \pi) / 4)$$

$$= 0,030 \text{ m}^3/\text{min} / ((0,08^2 \text{ m} * \pi) / 4)$$

$$= \underline{\underline{5,968 \text{ m/min}}}$$

$$V2 \text{ ret} = Q/A2$$

$$= Q / (((D^2 - d^2) * \pi) / 4)$$

$$= 0,030 \text{ m}^3/\text{min} / (((80^2 \text{ mm} - 25^2 \text{ mm}) * \pi) / 4)$$

$$= 0,030 \text{ m}^3/\text{min} / (((0,08^2 \text{ m} - 0,025^2 \text{ m}) * \pi) / 4)$$

$$= \underline{\underline{6,614 \text{ m/min}}}$$