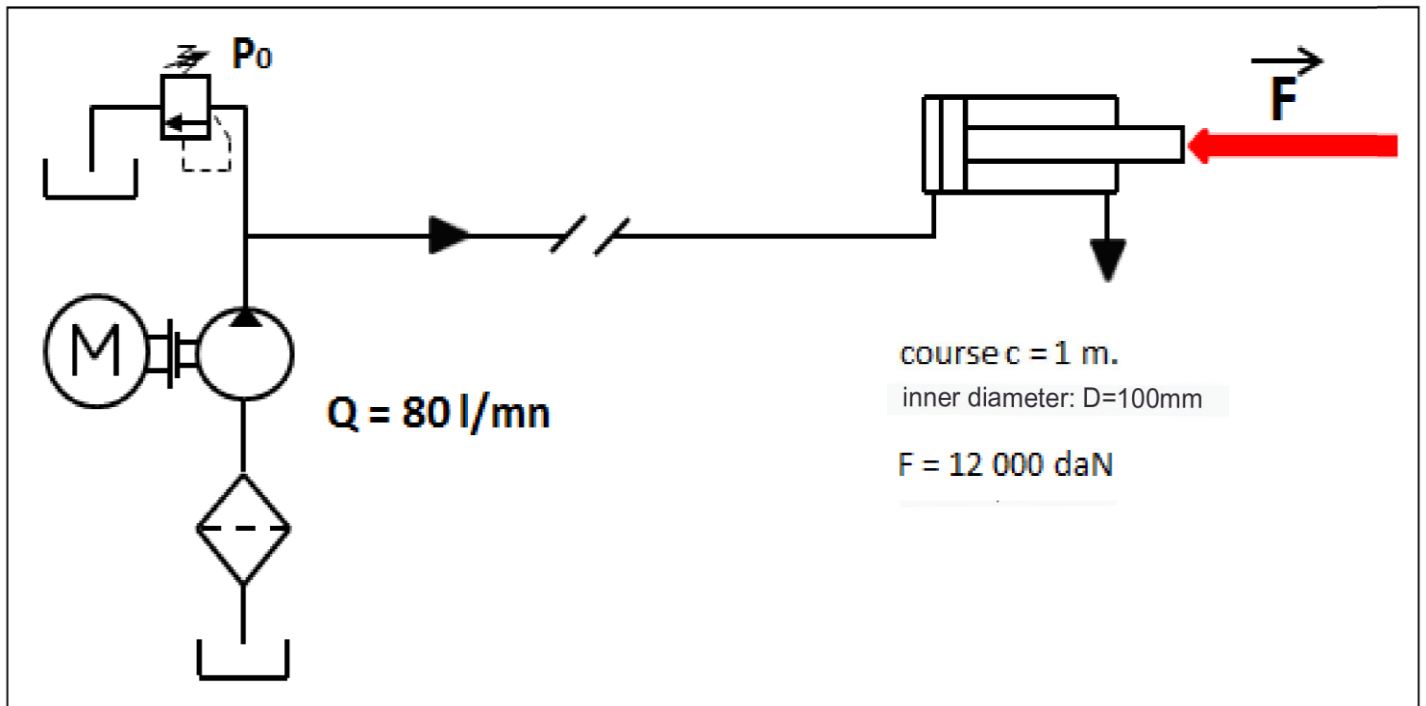


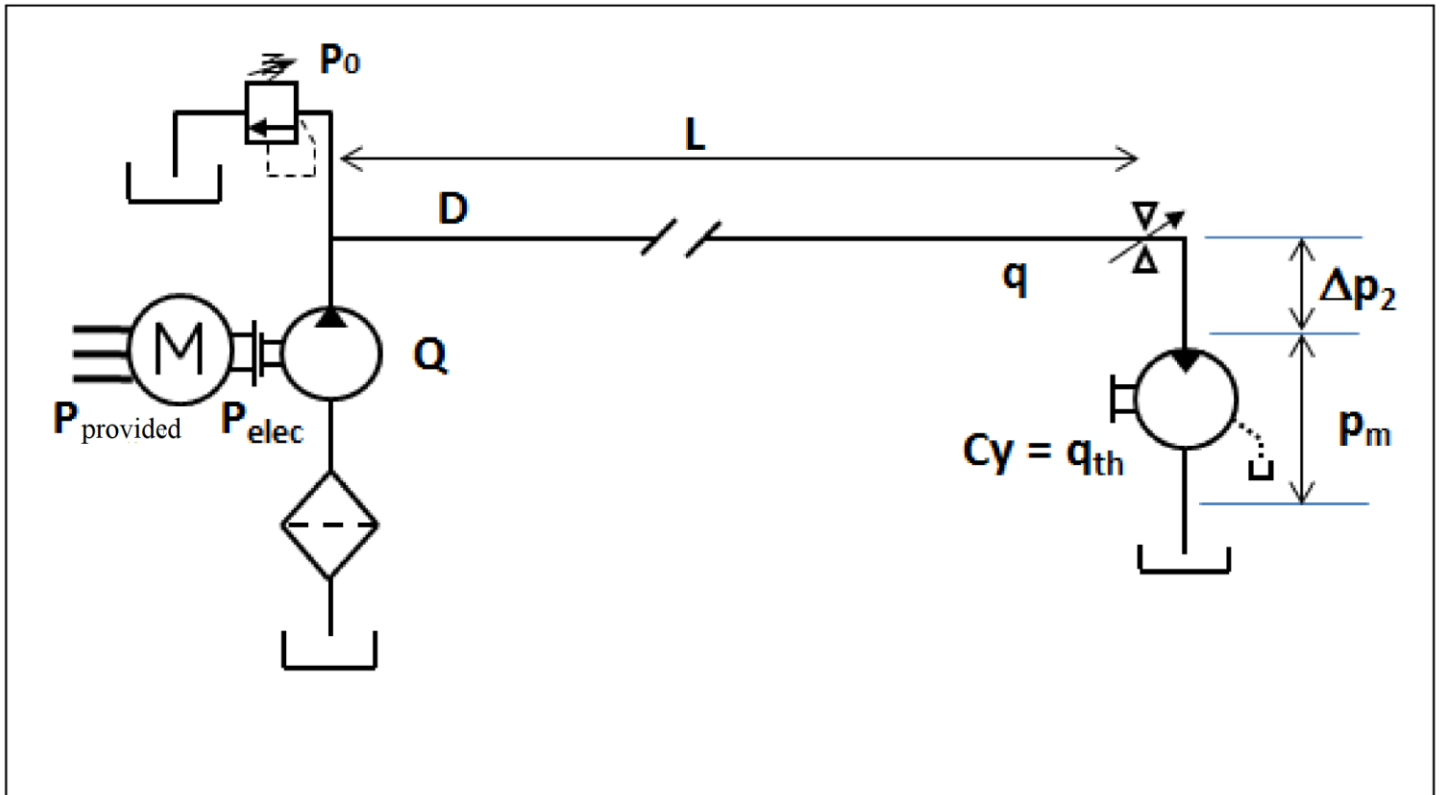
INDUSTRIAL HYDRAULICS

EXERCISE 1: calibration of the pressure limiter of a pump supplying a cylinder

A pump supplies a cylinder according to the diagram below:



- 1) What is the pressure in the cylinder assuming a performance of this receiving device equal to $\eta = 0,9$?
- 2) What is the displacement speed v of the cylinder rod?
- 3) What is the time t necessary to achieve a displacement equal to the stroke c ?
- 4) At what pressure P_0 must the pressure limiter be set if the pipe length from the pump to the cylinder is $L = 10$ meters with:
 - a pipe of Pext $d = 28 \text{ mm}$ - thickness $e = 3.2 \text{ mm}$
 - an oil of viscosity $\nu = 34 \text{ cst}$, of density $\rho = 0.87 \text{ gr/cm}^3$



$Q = 130 \text{ l/mn} - P_0 = 145 \text{ bar} - q = 125 \text{ l/mn} - P_m = 140 \text{ bar} - C_y = q_{th} = 75 \text{ cm}^3 - \eta_{v, \text{ mot}} = 0,9 -$

$\eta_{m, \text{ mot.}} = 0,9 - \rho = 0,9 \text{ kg/l} - \Delta p_2 = 0,5 \text{ bar} - P_{\text{elec}} = 34,15 \text{ kW} - \eta_{\text{elec}} = 0,85 -$

$D = 27.3 \text{ mm}$, inside diameter of a pipe {33.7 - 3.2 according to NF A49-330} - $L = 21.8 \text{ m}$

$v = 35 \text{ cst} - \xi = 1,93 -$

A fixed displacement pump providing a flow rate Q feeds a hydraulic motor through a flow limiter of the thin-walled type (thus temperature compensated). This flow limiter is set for a flow q ($< Q$).

- 1) What is the rotational frequency N (rpm) of the hydraulic motor, knowing that the displacement of the motor is C_y ? The displacement of a hydraulic motor is the theoretical volume q_{th} of fluid necessary to make it complete one revolution. The volumetric efficiency of this engine is $\eta_{v, \text{ mot.}}$.
- 2) What is the hydraulic power P_{hyd} necessary to ensure the operation of the hydraulic motor, knowing that the pressure difference between the inlet and the outlet of the motor is P_m ?

Note: it is possible to deal with question 4) before question 3) according to the method of calculation you choose:

- 3) What is the torque C on the output shaft of the motor, knowing that the mechanical efficiency of this motor is $\eta_{m, \text{ mot.}}$?
- 4) What is then the mechanical power P_m on the output shaft of this hydraulic motor?

- 5) The pressure limiter of the circuit being set to the value P_0 , what is the efficiency η_p of the pump, knowing that the output power of the electric motor is P_{elec} ?
- 6) What is the general efficiency η_t of the installation, knowing that the efficiency of the electric motor is η_{elec} ? Calculate the power $P_{supplied}$ consumed by the electric motor.
- 7) What is the head loss Δp_1 in the pipe of length L and diameter D which connects the pressure limiter to the flow limiter?
- 8) What is the passage diameter of the flow limiter, assuming that there is a pressure drop Δp_2 between this flow limiter and the hydraulic motor?
- The singular head loss coefficient of the flow limiter is equal to ξ .