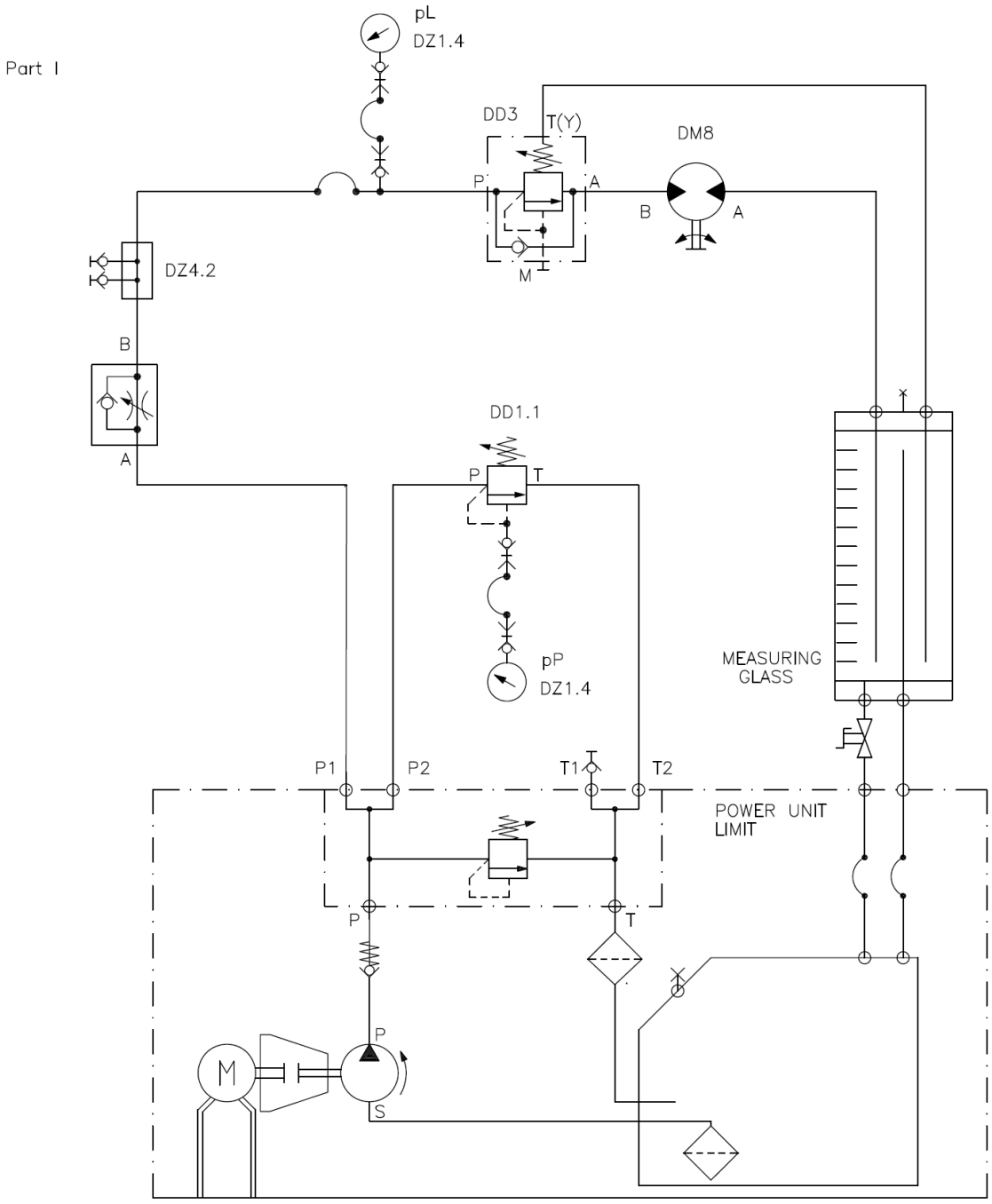
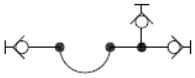
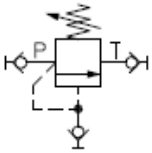
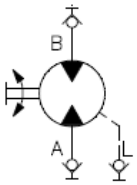
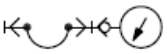
Speed Control

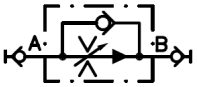
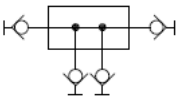
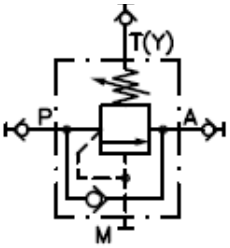
Description of experiment

In hydraulics there is a direct relationship between flow rate and actuator speed. This leads to the simple conclusion that in order to reduce the speed of an actuator we simply need to supply it with a lower flow rate. The throttle valve DF2.2 in the following circuit will add extra resistance and ultimately reduce the flow being delivered to the hydraulic motor enabling us to control the speed. The pressure control valve DD3 will allow you to simulate load on the hydraulic motor to see the effect that the load has on the motors speed.



Components:
You will require the following components:

1x	Hose assembly c/w gauge connection	
1x	Pressure relief valve DD1.1	
1x	Hydraulic motor DM8	
2x	Pressure gauge DZ4.1	

1x	Throttle valve DF2.2 (part I)	
1x	Pressure compensated throttle DF3(part II)	
1x	Connection piece DZ4.2	
1x	Pressure sequence valve DD3	

** If using subplate mounted valve type DF3 follow instructions in italics*
Pressure hoses
Stop watch

Before beginning the experiment read the **Rules for hydraulic trainer operation** sheet.

Mount the individual components on the training stand grid and interconnect them according to the hydraulic schematic

Experimental procedure

Steps in the experimental procedure:

1. Has your instructor checked the constructed circuit?
2. Check again that all connection hoses are firmly coupled.
3. Back out the adjustment of the pressure relief valve DD1.1 to ensure minimum pressure setting
4. Close the throttle valve DF2.2 completely (fully CW)
5. Open the shut-off valve on the measuring glass to allow it to drain to tank
6. Ensure that the red E-STOP button is not engaged on either side of the trainer (rotate button to reset)
7. Switch on the pump via the green START push button
8. Adjust the supply pressure relief valve DD1.1 until a pressure of 45 bar is read at gauge DZ1.4/pP
9. Open the fine throttle valve DF2.2 one complete turn
10. Adjust the loading valve DD3 until 10 bar is read at pressure gauge DZ1.4/pL (If you are unable to achieve a pressure of 10 bar start at the lowest obtainable pressure
11. Close the shut-off valve on the measuring glass
12. Measure the time required to fill a volume of 1 litre into the measuring glass and record this in the following table.
13. Open the shut-off valve to drain the measuring glass again
14. Set the pressure pL to each of the settings in the table. Measure and record the filling time without changing the setting of the throttle valve
15. Switch off the pump and drain the measuring glass

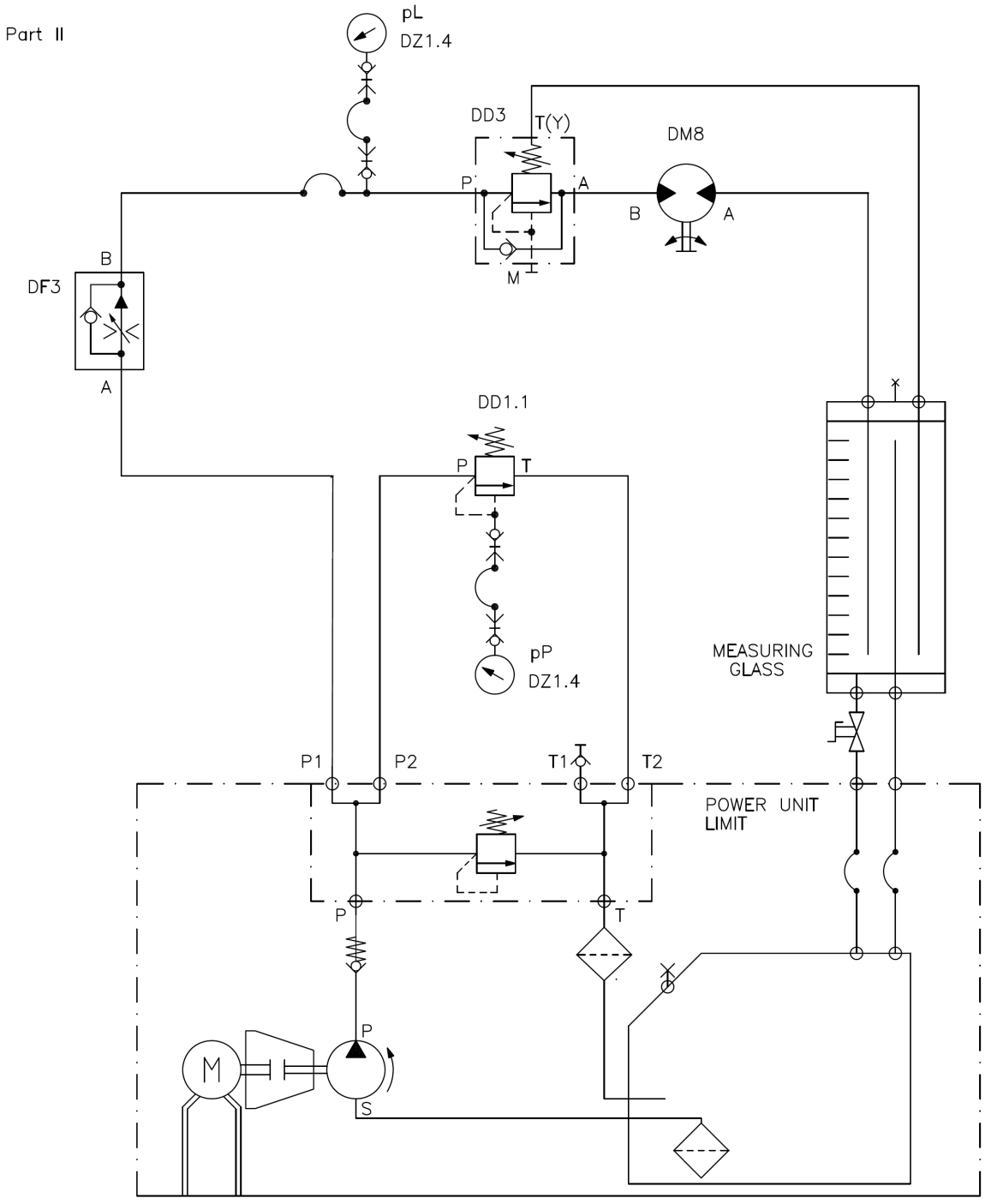
Calculate the respective volume flow Q for the measured times using the following formula:

$$Q = \frac{\text{volume (1 litre)}}{\text{measured time (sec)}} \times \frac{60 \text{ seconds}}{1 \text{ minute}}$$

$$Q = \frac{60}{\text{measured time (sec)}}$$

Load pressure set @ DD3	Resultant readings	
pL (bar)	t (sec)	Q (l/min)
10	11.9	5
15	13.2	4.5
20	15.1	4
25	17.1	3.5
30	21.2	2.8
35	26.9	2.2
40	52.1	1.2
45	-	-

Table – Part I


Part II
pL
DZ1.4
DD3
T(Y)
P
A
M
DM8
B
A
B
DF3
A
DD1.1
P
T
pP
DZ1.4
MEASURING
GLASS
x
P1
P2
T1
T2
POWER UNIT
LIMIT
P
T
P
M
S

Replace the throttle valve DF2.2 with a pressure compensated throttle valve type DF3 or DF3.1

1. Close the pressure compensated throttle valve DF3.1 completely (fully CW)

   Close the pressure compensated throttle valve DF3 by setting the scale indicator to zero
2. Open the shut-off valve on the measuring glass to allow it to drain to tank
3. Ensure that the red E-STOP button is not engaged on either side of the trainer (rotate button to reset)
4. Switch on the pump via the green START push button
5. Adjust the supply pressure relief valve DD1.1 until a pressure of 45 bar is read at gauge DZ1.4/pP
6. Open the pressure compensated throttle valve DF3.1 one complete turn

   Open the pressure compensated throttle valve DF3 to position 4 on the scale indicator
7. Adjust the loading valve DD3 until 10 bar is read at pressure gauge DZ1.4/pL (If you are unable to achieve a pressure of 10 bar start at the lowest obtainable pressure
8. Close the shut-off valve on the measuring glass
9. Measure the time required to fill a volume of 1 litre into the measuring glass and record this in the following table.
10. Open the shut-off valve to drain the measuring glass again
11. Set the pressure pL to each of the settings in the table. Measure and record the filling time without changing the setting of the pressure compensated throttle valve
12. Switch off the pump and drain the measuring glass

Calculate the respective volume flow Q for the measured times using the following formula:

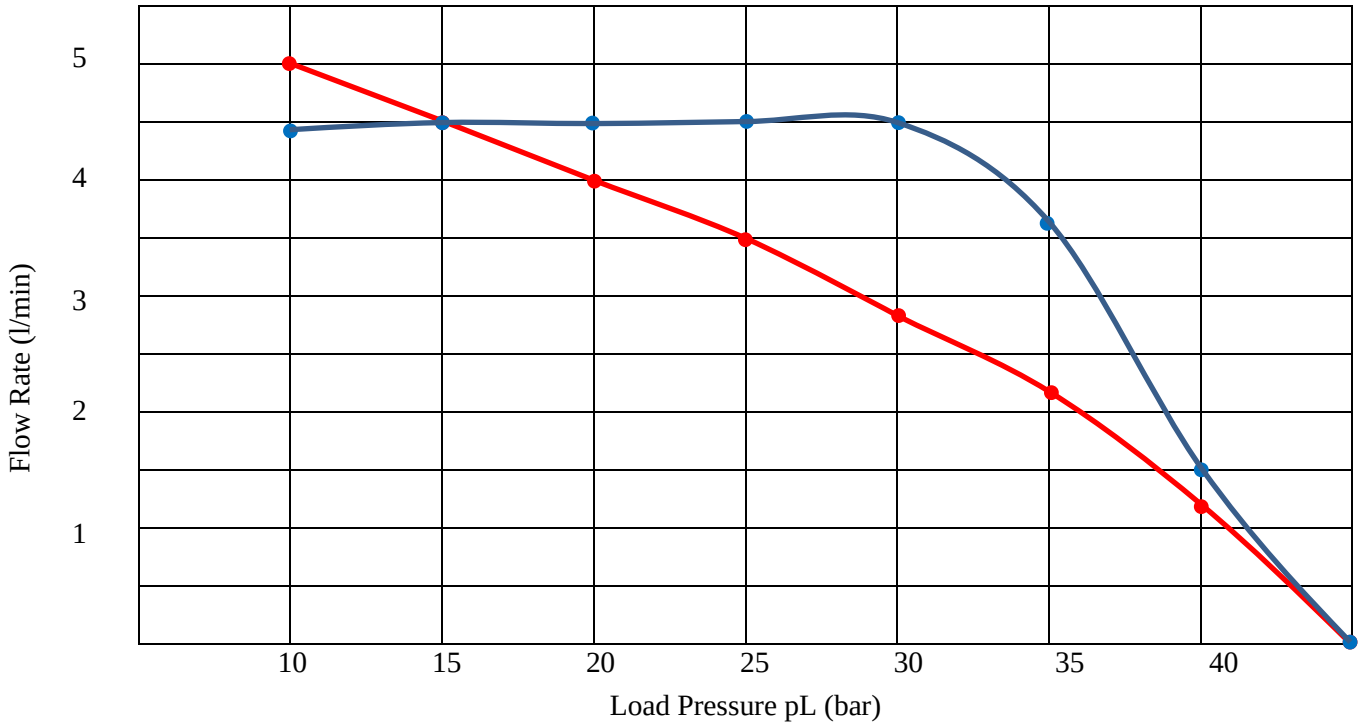
$$Q = \frac{\text{volume (1 litre)}}{\text{measured time (sec)}} \text{ x } \frac{60 \text{ seconds}}{1 \text{ minute}}$$

$$Q = \frac{60}{\text{measured time (sec)}}$$

Table – Part II

Load pressure set @ DD3	Resultant readings	
pL (bar)	t (sec)	Q (l/min)
10	13.5	4.4
15	13.3	4.5
20	13.3	4.5
25	13.3	4.5
30	13.2	4.5
35	16.9	3.6
40	39.4	1.5
45	-	-

Plot the load pressure (p_L) vs. flow rate (Q) information from the tables from Part I and Part II on the following graph.



Characteristic curve

Conclusions

I. What happened to the flow rate as the load pressure changed in part I vs. part II

Part I – flow decreased as the load pressure increased
Part II – flow stayed the same as the load pressure increased (up to 30 bar)

Why?

In part II we used a pressure compensated valve

II. When would it be advantageous to use a pressure compensated throttle valve instead of a standard throttle valve?

When we need to maintain constant actuator speed despite varying load pressures

III. The pressure compensated throttle valve can be referred to as a “flow control valve”. Why would it be incorrect to call the standard throttle valve a “flow control valve”?

The throttle valve only creates a resistance. If the load pressure or supply pressure (pressure drop) changes the flow rate across the valve will change.