



## Worksheet FB1 & Training Record Formulas and Fundamentals

## Hydraulics Fundamentals

Email:

Course:

Provider:

Expected Outcomes: (60-120mins)

To understand the basic formulas on which all hydraulic systems are based.  
To perform simple calculations to size system pumps and actuators.

Previous Knowledge Required:

Students should have completed worksheet IH1 'Introduction to hydraulics' or have a basic understanding of what hydraulics is used for and which components are employed.

Certificate of Achievement:



Click the email button (shown left, that will appear within each app) to post your results, once the training module has been completed. Enter your email or the email for your external training provider. e4training.com will also receive a copy of the results to include in the certificate assessment process.

*Interactive tutorial*

Pressure generates a higher force on a larger cylinder

Load Force: 1000 N, 4000 N

Pressure = 100 bar

Dia. B = 22.4 mm

Area B =  $\pi D^2/4 = 400 \text{ mm}^2$

Force = Pressure \* Area = 4000 N

Complete the 'Formulas and Fundamentals' tutorial at [www.e4training.com/hydraulic\\_courses/microtutor1.php?wtformula](http://www.e4training.com/hydraulic_courses/microtutor1.php?wtformula) (or via the phone app or CD/download)  
Complete quick quiz at end and post results.

Date, score & time:

Tick when posted

*Coursework investigations*

Load Force: 1000 N, 4000 N

Pressure = 100 bar

Dia. B = 22.4 mm

Area B =  $\pi D^2/4 = 400 \text{ mm}^2$

Force = Pressure \* Area = 4000 N

Study the 'Pressure and Force' relationships at [www.e4training.com/hyd\\_formula/pressure1.php](http://www.e4training.com/hyd_formula/pressure1.php) and [pressure2.php](http://www.e4training.com/hyd_formula/pressure2.php) (or via the phone app, CD, or download)

- Understand the relationship between force, pressure, and area.
- Understand where pressure losses occur in a hydraulic system.
- Discuss how cylinder area affects forces and pressures

Complete

Pump Displacement: 2.4 L/min

Cyl. Vel. = 0.1 m/sec

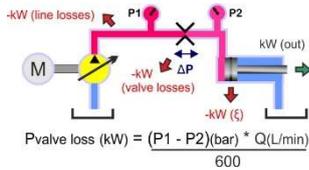
Cylinder Speed = Flow / Cyl. Area = 2.4 L/min / (400 mm² \* 60sec/min) = 100 mm/sec

Area = 400 mm²

Study 'Flow Displacement and Control' formulas at [www.e4training.com/hyd\\_formula/flow1.php](http://www.e4training.com/hyd_formula/flow1.php) and [flow2.php](http://www.e4training.com/hyd_formula/flow2.php)

- Understand the relationship between volume, displacement, pump speed, and flow
- Understand how orifice restrictions control flow.
- Understand how pipe diameter affects fluid velocity.

Complete



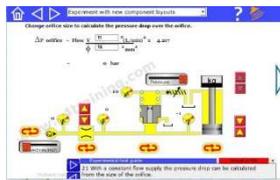
Study 'Fluid Power and its Losses' at

[www.e4training.com/hyd\\_formula/power1.php](http://www.e4training.com/hyd_formula/power1.php) and [power2.php](#)

- Understand the relationship between pressure, flow, power, and system efficiencies.
- Understand the input power, output power, and energy losses.
- Review energy losses in a hydraulic system.

Complete

## Virtual test rig experiments



Experiment with the 'control valve fundamentals' simulation at

[www.e4training.com/hyd\\_formula/pressure3.php](http://www.e4training.com/hyd_formula/pressure3.php)

- Change supply pressure, cylinder area and mass, to observe effects.
- Select 'constant pressure over an orifice' from drop-down menu.
- Change orifice area and observe cylinder speed (flow) changes.
- Change pressure drop across the orifice and observe flow changes.
- Discuss the factors affecting the control of the cylinder.

Tick when posted

## Coursework assignments



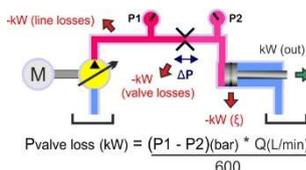
Understand the relationship between force, pressure and area:

- Calculate the pressure generated by a load on a cylinder area.
- Calculate the load that a pressure can lift.
- Discuss how cylinder area affects forces and pressures



Understand the relationship between volume, displacement, pump speed and flow:

- Calculate the flow based on pump displacement and speed.
- Calculate the cylinder speed based on area and flow rate.
- Calculate the motor speed and torque based on displacement.
- Discuss how orifice restrictions control the flow.
- Discuss the relationship between flow and pressure drop.

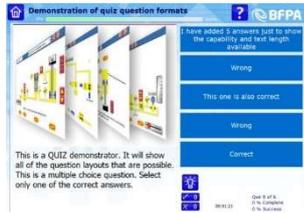


Understand the relationship between pressure, flow, power, and system efficiencies:

- Calculate the power based on flow and pressure.
- Discuss the potential energy losses in a hydraulic system.

Sample calculations

Submit calculations as part of the design project.



Complete the 'formulas and fundamental questions' at [www.e4training.com/hydraulic\\_test2.php?Quiz - Intermediate Hydraulics](http://www.e4training.com/hydraulic_test2.php?Quiz - Intermediate Hydraulics)

(or via the phone app, CD or download)

Post result when complete.

Quiz name, date, score

Tick when posted

## And Finally:

Complete this worksheet and keep for your records. Submit the written coursework to e4training.com or your training course provider. Application result postings will be collated automatically by the course provider; e4training.com will also receive a copy of the results to include in the certificate assessment process.

## Related Worksheets:

Visit [www.e4training.com/hydraulic\\_courses/](http://www.e4training.com/hydraulic_courses/) to find the next worksheets related to your course.