



# Worksheet HF03 & Training Record

## Flow Theories and Formulas

# Hydraulics Fundamentals

Email:

Course:

Provider:

### Learning Objectives/Expected Outcomes: (60-120mins)

1. To understand the relationship between volume, flow, and fluid velocity.
2. To perform simple calculations for volume changes and flow rate.
3. To understand that flow can be controlled by pump displacement, orifice restrictions, or motor displacement.

### Previous Knowledge Required:

Students should have completed worksheet HF02 'Pressure theories and formula' along with a basic knowledge of hydraulic components and systems.

### Terminology:

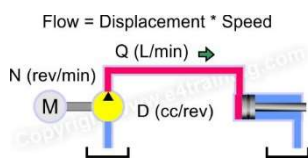
Flow, volume, fluid velocity, pump displacement, cylinder area, pipe size, closed circuit, secondary control.

### Record of Achievement:



Click the email button (that will appear within each app) to post your results, once training is complete. Enter your training provider or your own email address. Also record progress, times, scores etc. on this training record sheet and keep together with any additional written work or sample calculations.

### Coursework investigation and instructional video



Study the 'Flow and Displacement' relationships at

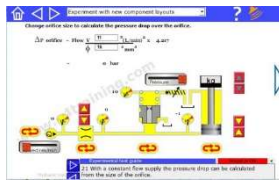
[www.e4training.com/hyd\\_formula/flow1.php](http://www.e4training.com/hyd_formula/flow1.php) and flow2.php

- Understand the relationship between volume, flow, displacement, and area.
- Make simple flow rate and volume displacement calculations.
- Appreciate the flow rate can be set by an orifice or by a pump or motor displacement.

Complete



## Virtual test rig experiments



Experiment with the 'control valve fundamentals' simulation at [www.e4training.com/hyd\\_formula/flow3.php](http://www.e4training.com/hyd_formula/flow3.php)

- Follow the suggested exercises and observations list below the simulation.
- Run the experiments, answer the questions, and click the buttons to see the answers.

Explore how supply pressure, cylinder loads, and orifice pressure drops rely on and interact with each other.

Date, score & time:

Tick when posted

## Practical & Coursework exercises



Raise and lower a hydraulic jack. Calculate the area ratio for the pump and raise cylinders [www.e4training.com/hyd\\_formula/flow1.php](http://www.e4training.com/hyd_formula/flow1.php)  
Understand how mechanical advantage is achieved by using two cylinders with different areas. Demonstrate the results on the basis of hand pumps.

Submit notes

Submit calculations on separate sheet

$$v \text{ (m/sec)} = \frac{Q \text{ (L/min)}}{\pi * \text{Ø}^2 \text{ bore (mm}^2) / 4}$$



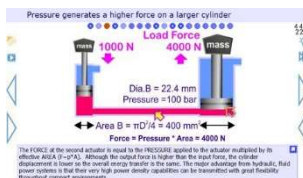
- Calculate the volume displaced by a cylinder.
- Calculate the flow rate due to pump displacement and speed.
- Calculate the flow across a fixed orifice with pressure drop across it.
- Calculate the fluid velocity for a certain pipe size.

See examples [www.e4training.com/hyd\\_formula/flow1.php](http://www.e4training.com/hyd_formula/flow1.php)

Submit calculations

Submit calculations on separate sheet

## Interactive tutorial



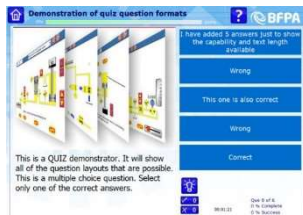
Complete the 'Formulas and Fundamentals' tutorial at [www.e4training.com/hydraulic\\_courses/microtutor1.php?wtformula](http://www.e4training.com/hydraulic_courses/microtutor1.php?wtformula)  
Complete quick quiz at end and post results.

Date, score & time:

Tick when posted



*Interactive quiz to check and reinforce learning*



Complete the 'Formulas and fundamentals' questions at [www.e4training.com/hydraulic\\_test2.php? Quiz - Hydraulics part 1](http://www.e4training.com/hydraulic_test2.php? Quiz - Hydraulics part 1)  
Post result when complete.

Quiz name, date, score

Tick when posted

*Key questions / Plenary*

- Can you explain the relationship between cylinder area, volume, and flow?
- Can you explain the relationship between pump displacement, speed, and flow?
- Can you explain the relationship between flow, pipe size and fluid velocity?
- Can you explain the 3 different ways flow can be set or controlled?

Submit written answers

Tick when complete

**And Finally:**

Complete this worksheet and keep for your certification records. Submit any written coursework etc. to your training course provider.

**Follow-on Course Worksheets:**

Potential follow-on worksheets include:

HF04 – Hydraulic power and torque fundamentals

For more specialist course worksheets visit

[www.e4training.com/hydraulic\\_courses/worksheets1.php](http://www.e4training.com/hydraulic_courses/worksheets1.php)