engineering adventures

Worksheet HF03 & Training Record Flow Theories and Formulas		Hydraulics Fundamentals
Email:	Course:	Provider:

Learning Objectives/Expected Outcomes: (90-180mins)

1. To appreciate the relationship between volume, flow, and fluid velocity.
2. To perform simple calculations for volume changes and flow rates.
3. To appreciate 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.

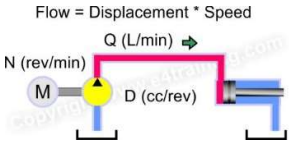
Terminology:

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

Record of Achievement:

Click the email icon to post your results, once training is complete. Enter an LRS username and endpoint details or see www.e4training.com/xapi/ for free examples. Keep a record of any written work or worked calculations etc.

Coursework investigation and instructional video



Study the 'Flow and Displacement' relationships at www.e4training.com/hyd_formula/flow1.php and flow2.php

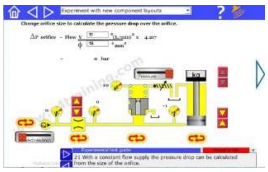
- Understand the relationship between volume, flow, displacement, and area.
- Make simple flow rate and volume displacement calculations.
- Appreciate that flow rate can be set by an orifice or by a pump or motor displacement.

Estimated time: 30 minutes, skill level 4-6

Date complete:

Complete ☐

Virtual test rig experiments



Experiment with the 'control valve fundamentals' simulation at 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.

Estimated time: 30 minutes, skill level 4-6

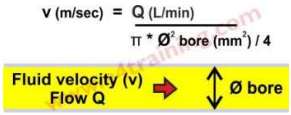
Date, score: Tick when posted ☐

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 Understand how mechanical advantage is achieved by using two cylinders with different areas. Demonstrate the results based on the number of hand pumps.

Estimated time: 10 minutes, skill level 4-6

Submit notes: Submit calculations on a separate sheet ☐



- 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 a pressure drop across it.
- Calculate the fluid velocity for a certain pipe size.

See examples www.e4training.com/hyd_formula/flow1.php

Estimated time: 40 minutes, skill level 4-6

Submit calculations Submit calculations on separate sheet ☐

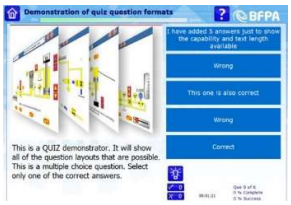
Interactive tutorial

Complete the 'Formulas and Fundamentals' tutorial at www.e4training.com/hydraulic_courses/microtutor1.php?wtformula Complete quick quiz at end and post results.

Estimated time: 10 minutes, skill level 4-6

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
Post result when complete.

Estimated time: 10 minutes, skill level 4-6

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

Notes