

Experiment 1

CALIBRATION OF BOURDON GAUGE

INTRODUCTION:

The bourdon gauge is the most popular pressure measuring device for both liquids and gasses. It can be connected to any source of pressure such as a pipe or vessel containing a pressurized fluid. The connection can either be direct or via a small tube called a capillary tube. This means that it can be mounted at any convenient location. It is also very versatile in that it can be designed to operate over virtually any range of pressures. The Bourdon gauge normally measures so called Gauge Pressure, which is the difference between the pressure in the pressure source and the current atmospheric pressure. It can however be modified to measure difference in pressure between two sources of pressure (i.e. pressure difference or differential pressure). The Bourdon gauge is an indirect measuring device which depends for its operation on the tendency of an internally applied pressure to cause an initially bent tube (called a bourdon tube) to straighten. Because the measurement is indirect it is necessary to calibrate the gauge before it can be use.

The calibration consists of applying a known pressure to the gauge and noting the position of the gauge needle on the scale. The gauge can be calibrated in a wide variety of units to suit the particular application provided that there is a linear relationship between actual pressure and the unit of calibration.

OBJECTIVE:

- To perform pressure calibration on a Bourdon tube pressure gauge using a dead weight tester.
- To establish the calibration curve of the Bourdon Gauge

APPARATUS:

- Bourdon Gauge and dead weight tester
- Set of Test weights
- Laboratory Scales

THEORY:

The use of the piston and weights with the cylinder generates a measurable reference pressure, P:

$$P = \frac{F}{A} (\text{Pascal})$$

Where

$$F = Mg$$

And

F: is the force applied to the liquid in the liquid in the calibrator

M: is the total mass (including that of the of the piston)

A: is the area of piston

The area of the piston can be expressed in terms of its diameter, d, as:

$$A = \frac{\pi d^2}{4}$$

PROCEDURE:

The weight of the Piston, and its cross sectional area should be noted. To fill the cylinder, the piston is removed, and water is poured into the cylinder until it is full to the overflow level. Any air trapped in the tube may be cleared by tilting and gently tapping the apparatus. In point of fact, a small amount of air left in the system will not affect the experiment, unless there is so much as to cause the piston to bottom on the base of the cylinder. The piston is then re-placed in the cylinder and allowed to settle. A spirit level placed on the platform at the top of the piston may be used to ensure that that the cylinder is vertically upright. Weights are now added in convenient increments, and at each increment, the pressure gauge reading is observed. As similar set of results is then taken with decreasing weights. To guard against the piston sticking in the cylinder, it is advisable to rotate the piston gently while the pressure gauged is being read.

TABLE OF OBSERVATIONS AND CALCULATIONS:

All readings and calculations are to be tabulated as follows:

Data for the Piston:

Mass of the piston (Mp) = 498g ≈ 0.5Kg

Diameter of the piston (d) = 0.01767m

Area of piston A(m ²)	Mass of weights M _w (Kg)	Gauge reading G(kPa)	Cylinder pressure P(kPa)	Absolute gauge error (kPa)	%Gauge error

Relative Error = (Measured Value – Actual Value) / Actual Value

Percent Error = | Relative Error | × 100

Note: Also, show the sample calculation to calculate the Relative Error and Percent Error.

GRAPHICAL RELATIONSHIP:

Plot the following graphs:

- Actual Pressure against Measured Pressure (Gauge Reading)
- Percent Error against Measured Pressure (Gauge Reading)

CONCLUSION AND RECOMMENDATIONS:

- Comment on the accuracy of the gauge.
- Is the relative height between the calibrator and the gauge important in calibration?
- General comments about the experiment
- Your recommendations