PROJECT ABSTRACT

Hydraulic Brake Pressure Test Rig

A bench brake-hydraulics rig: master cylinder with pedal lever, real caliper and rotor, bourdon pressure gauge and measured pedal-force input for Pascal's-law verification. Delivered built-to-order with rig, drawings, test procedure, report, PPT and viva kit.

01. Title

Hydraulic Brake Pressure Test Rig

02. Introduction / Background

Every driver trusts that a light foot on the pedal becomes tonnes of clamping force at the disc — hydraulic advantage working quietly through the master cylinder, lines and caliper pistons. In the classroom this is a formula: force times area ratio. In the lab it is almost never measured, because real brake systems are sealed, safety-critical assemblies students cannot instrument. The gap is a dedicated, safe, open test rig where the whole chain is visible and every variable measurable: pedal force in, line pressure through the system, clamping behavior out. This project builds it with real brake hardware on a rigid test frame.

03. Problem Statement

Brake-hydraulics teaching needs measured data, not just the formula: how line pressure actually responds to pedal force, how the bore-area ratios predict it, and how air in the lines corrupts everything. The project addresses this with a static test rig — master cylinder, pedal lever, lines, caliper, rotor and a teed-in pressure gauge — where the student applies known forces and plots the measured pressure characteristic against theory.

04. Objectives

- Build a rigid test frame carrying a master cylinder, pedal lever, lines, caliper and rotor.
- Measure pedal input force with a spring scale / load cell.
- Read live line pressure on a bourdon gauge teed into the circuit.
- Provide the proper brake-fluid bleed procedure as a mandatory step.
- Guide the student to plot measured pressure vs the Pascal's-law prediction.
- Deliver fabrication drawings, hydraulic schematic, report, PPT and viva Q&A.

05. Proposed Methodology

The rig is fabricated on a welded steel frame holding the master cylinder (with reservoir), a pivoted pedal lever with return spring, rigid/braided lines to the caliper and rotor, and a bourdon-tube gauge teed into the line. Pedal force is applied through a spring scale or load cell. The student bleeds the system per the procedure, then runs a stepped force series, recording paired pedal-force and line-pressure readings on the logging sheets, and plots them against the theoretical curve from the bore areas.

06. System Architecture / Working

Known pedal force enters through the lever, which multiplies it into the master-cylinder pushrod. The cylinder pressurizes the fluid; pressure transmits equally through the lines to the caliper pistons, which clamp the rotor. The teed gauge reads line pressure live. The student's stepped series yields the measured pressure-vs-force characteristic for comparison with the Pascal's-law prediction, including an honest analysis of deviation.

07. Hardware / Software Requirements

- Brake master cylinder with reservoir
- Pedal lever assembly with pivot and return spring
- Brake caliper + rotor disc
- Bourdon-tube hydraulic pressure gauge
- Spring scale / load cell
- Steel-braided / rigid brake lines with fittings
- Welded steel test frame
- Brake fluid, bleed kit, service tools
- Stepped test procedure with data-logging sheets

08. Expected Outcomes

- A working rig showing live line pressure against measured pedal force.
- A student-plotted pressure-vs-force characteristic with theory comparison.
- A documented bleed procedure and its effect on readings.
- A complete report, PPT and viva Q&A on brake hydraulics and experimental method.

09. Applications

- Automobile and mechanical teaching laboratories.
- Demonstrating Pascal's law on real hardware.
- Student experimental studies of hydraulic advantage.

10. Future Scope

- Pressure transducer with data-logger for automated curves.

- Dual-circuit (front/rear split) comparison rig.
- Pad-wear vs clamping study module.
- ABS modulator cutaway as a companion demonstrator.