

HYDRAULICS BENCH AND EXPERIMENTS

INTRODUCTION

Cussons P6100 Hydraulics Bench and the various ancillary modules available form a comprehensive laboratory facility which enables a detailed Mechanics of Fluids Experimental Course to be followed. The equipment is designed to provide a clear visual appreciation of hydraulic principles, and has been featured by BBC Television on the Open University Mechanics of Fluids course.

The experimental topics covered include:

- ◆ Centrifugal pump characteristics
- ◆ Flow in pipes and pipe fittings
- ◆ Flow through orifices and over weirs
- ◆ Flow in channels
- ◆ Bernoulli's experiment
- ◆ Water flow measurement
- ◆ Hydrostatics
- ◆ Free and forced vortices
- ◆ Hydraulic machines
- ◆ Pipe networks
- ◆ Reynolds number

EXPERIMENTAL PACKAGE

Each documented experimental package contains:

- full operating instructions for experiment concerned
- circuit diagrams and apparatus requirements
- relevant theory
- sample results and graphs where applicable

Pertinent questions are posed for the student to answer, ensuring that the facts to be learned from the experimental results are clearly brought to the attention of the student.

DESCRIPTION

This unit provides the basic services for the pumping and volumetric measurement of the water supply with which all the additional accessories and experiments are used.

The working surface of the unit is in fibreglass, moulded to provide a recessed area on which to mount experiments. An integral weir tank is provided along with a volumetric measuring tank which is stepped to afford accurate measurement of both high and low flow rates. The measuring tank discharges into a fibreglass sump tank by means of a quick acting PVC ball valve.

A variable speed electric motor drives a centrifugal pump which delivers water to the outlet at the working surface for connection to the individual experiments. The flow is regulated by a brass valve. Pressure tapping points enable the pressure at pump suction, delivery, and at a point immediately prior to the experiment to be measured. A pressure gauge scaled 0-4 bar coupled to a rotary selector switch mounted on the panel together with a pump suction gauge are provided for these measurements.

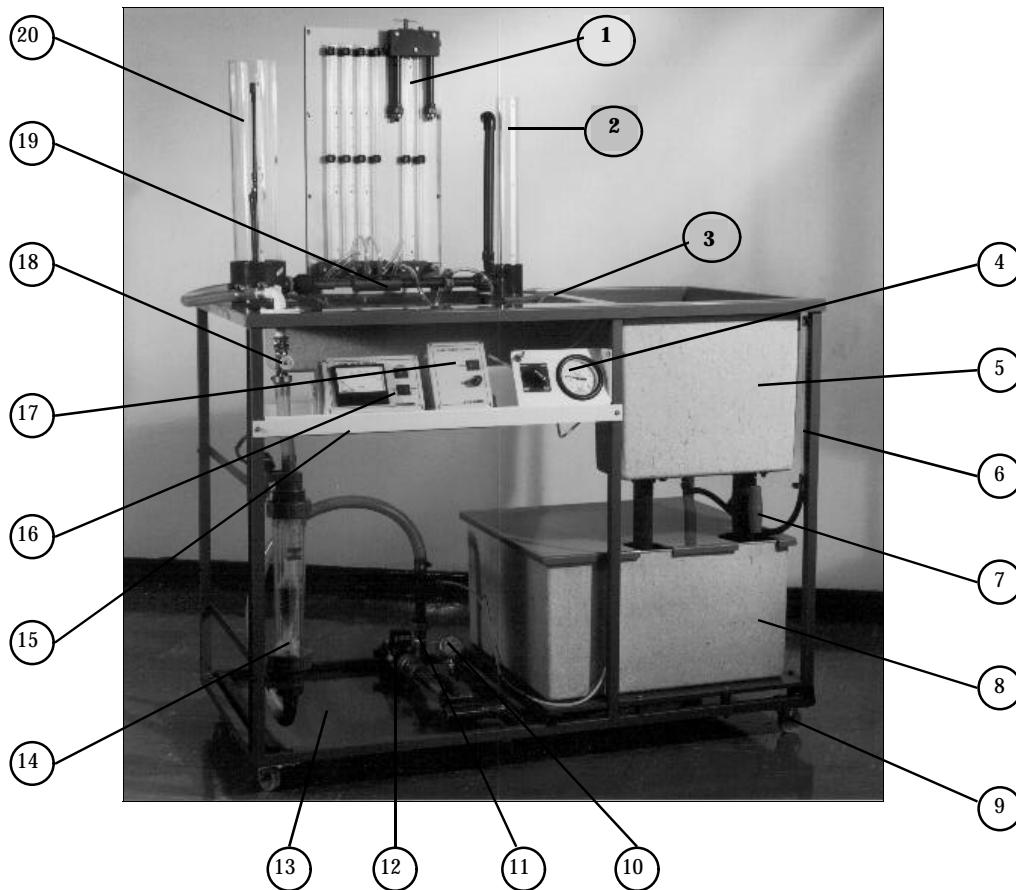
The component parts are supported on a robust stove enamelled steel frame mounted on castors.

- By using an open construction a visual appreciation of the system being studied is obtained and hence the implications of variation of circuit parameters is easily appreciated.
- Materials used in the Bench construction and its modules have been carefully selected to minimise corrosion problems.
- Stepped volumetric measuring tank ensures accurate monitoring of high and low rates of flow.
- Direct indication of flow rate given by calibrated weir.
- Self contained water recirculating system

SPECIFICATION

Sump tank capacity	- 120 litres	Length	1400mm
High flow volumetric tank	- 40 litres	Width	740mm
Low flow volumetric tank	- 10 litres	Height	1100mm
Pump	42 litres/min. against 5m head. Max. head of 20m of water at zero flow rate.	Weight	70 kg

Electrical requirements 240 volt (alternatively 110V). Single phase 50/60 Hz supply (state voltage requirements when ordering) .



Ref.No.	Item	Ref.No.	Item
1	MANOMETER BOARD P6106	11	SUCTION VALVE
2	VARIABLE HEAD OUTLET TANK P6104	12	CENTRIFUGAL PUMP
3	CALIBRATED WEIR	13	MOUNTING POSITION FOR AUXILIARY PUMP P6101
4	PRESSURE GAUGE AND MULTI-POINT PRESSURE TAPPING SWITCH	14	ROTAMETER P6108
5	STEPPED MEASURING TANK	15	MAIN ON/OFF SWITCH (LOCATED UNDER PANEL)
6	SIGHT GLASS	16	PUMP SPEED DISPLAY P6102
7	MEASURING TANK OUTLET VALVE	17	PUMP SPEED CONTROL
8	RESERVOIR/SUMP TANK	18	FLOW REGULATING VALVE
9	CASTORS FOR MOBILITY	19	EXPERIMENTAL SECTION
10	SUCTION GAUGE	20	CONSTANT HEAD INLET TANK P6103

ACCESSORIES

The basic P6100 unit can be augmented by the addition of accessories as follows:-

The accessories may be factory fitted, where applicable, or added by the Customer at a later date if desired.

P6101 AUXILIARY PUMP & SPEED CONTROL UNIT

A second variable speed centrifugal pump with associated pipe work is available to increase the water flow capacity enabling the bench unit to service a series of larger scale experiments. The valving arrangement also enables the two pumps to be run in either series or parallel configuration as in the Series and Parallel Pump Test detailed later. The speed control unit allows continuously variable speed control of the auxiliary pump, which in tandem with the main pump and controller allows pump characteristic curves to be obtained at different speeds.

P6102 PUMP SPEED DISPLAY

This unit displays centrifugal pump speed enabling pump characteristics to be determined at different known speeds. A switch enables the speeds of both the bench pump and the auxiliary pump (if fitted) to be selected and displayed.

P6103 CONSTANT HEAD INLET TANK

This unit provides a constant head of water for experiments requiring it, a two position overflow is arranged so that either a 250mm or 500mm head can be provided to suit experimental requirements. The tank is fitted with two connection points, one in the base and one in the side, for the attachment of experiments (P6223/4).

P6104 VARIABLE HEAD OUTLET TANK

The outlet tank is used in conjunction with the inlet tank to mount various experiments and to provide a regulated total head across the experiment. The outlet head can be controlled at any value between 50 and 300mm above the experiment centre line height.

P6105 FEED BLOCK

This item is provided for use instead of the constant head inlet tank for those experiments which need an inlet head of more than 500mm. The feed block can supply the full head available from the pump(s).

P6106 MANOMETER

This item is necessary for those experiments where determination of pressure drop or head loss is required. The unit consists of four open vertical manometer tubes enabling measurements to be undertaken at four points simultaneously, and a water on mercury 'U' tube for the measure of higher values of differential pressure.

P6107 HOOK GAUGE AND SCALE

This item enables vertical measurement to be undertaken with a linear scale at a series of points along the horizontal. For use with P6223/4 Orifice Experiments for plotting trajectory of jets, and with P6225/6 Weir Experiments for determining the water height above the weir.

P6108 ROTAMETER

A variable area flow meter mounted adjacent to the front panel affords direct readings of the total flow rate from the pump or pumps, rates from 0.4 - 4.0 m³/h can be measured.

P6109 WATTMETER

This meter is designed to measure the electrical power input to the pump motor, thus providing data required for efficiency calculations etc.

EXPERIMENTS

PUMP CHARACTERISTICS

SINGLE PUMP TEST

Description

Characteristics of the bench motor pump unit can be obtained with the basic bench together with the true constant speed characteristics of the centrifugal pump. Pump speed can be displayed with the addition of P6102 Pump Speed Display.

Suction and delivery pressures can be varied by means of the inlet and outlet valves on the Bench, and cavitation effects can be observed through the clear piping at the pump and delivery points. The further addition of P6109 Wattmeter enables a study of overall efficiencies to be undertaken.

Experimental Capabilities

- Curves illustrating head/flow rate relationship for different pump speeds can be obtained.
- Specific speed can be determined by the application of dimensional analysis techniques.
- Power requirements at varying flow conditions can be investigated and overall efficiencies of the pump unit determined.
- Pump cavitation effects can be visually observed and relevant suction conditions evaluated.

Accessories Required

P6102 Pump Speed Display

P6109 Wattmeter (for power and efficiency evaluation)

SERIES AND PARALLEL PUMP TEST

Description

The addition of P6101 Auxiliary Pump and Speed Control Unit and P6102 Pump Speed Display to the basic Hydraulics Bench enables a study of resultant flows and heads for two similar independent pumps operating in a series or parallel configuration to be carried out.

The use of two pumps also allows the Hydraulics Bench to act as a service unit for larger items which demand an increased flow, such as P5160 Friction in Pipes and Fittings Apparatus and P6245 Flow Channel.

Experimental Capabilities

- Parallel operation characteristics of two similar pumps operating at same speed.
- Series operation characteristics of two similar pumps operating at same speed.
- Parallel operation characteristics of two pumps operating at different speeds.
- Series operation characteristics of two pumps operating at different speeds.

Accessories Required

P6101 Auxiliary Pump and Speed Control

P6102 Pump Speed Display

P6109 Wattmeter

P6100 HYDRAULICS BENCH

Services required:

Single phase AC power supply 240/110v 50/60Hz.

(please state details when ordering)

Shipping specifications:

Case size : 178 x 94 x 130cms

Gross weight: 145 Kg

The following experiments are available for use with the P6100 Hydraulics Bench and individual specification sheets covering each of the subject areas are available on request.

P6220 Laminar Flow Apparatus

P6221 Losses in Pipes & Fittings

P6222 Entry/Exit & Contraction/Expansion Losses

P6223 Elementary Orifices

P6224 Advanced Orifices

P6225 Elementary Weirs

P6226 Advanced Weirs

P6227 Venturi Meter

P6228 Orifice Plate

P6229 Turbine Meter

P6230 Pitot Static Tube

P6231 Bernoulli's Experiment

P6232 Hydraulic Ram

P6233 Impact of Jets

P6234 Calibration of Pressure Gauge

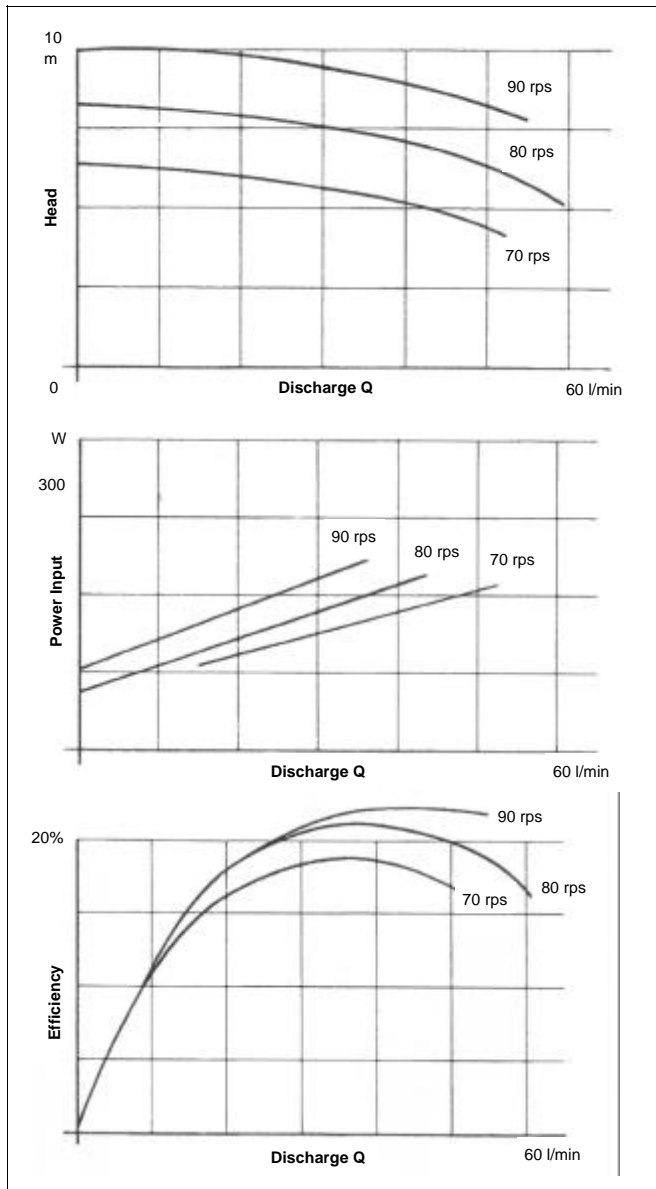
P6235 Flat Bottomed Vessel

P6236 Alternative Hull Sections

P6237 Centre of Pressure Apparatus

P6238 Free & Forced Vortex Apparatus

P6239 Water Flow Measurement Techniques



P6240 Pelton Wheel

P6245 Flow Channel **

P6248 Osborne Reynolds Apparatus

P6510 Network of Pipes Apparatus

P5160 Large Scale Friction Loss in Pipes & Fittings **

** A stand alone recirculatory water supply unit P5161, which replaces the hydraulics bench, is available to provide sufficient water to these large scale experiments.

Complementary Equipment - separate leaflets are available on request.

P6242 Hydrostatics Bench

P6247 Water Flow Visualisation Unit

P6250 Universal Water Pump Test Set

P6290 Francis Turbine Set

P6520 Permeability Apparatus

P6530 Hydrology Apparatus

Cussons Technology Ltd.

102 Great Clowes Street, Manchester M7 1RH, England

Tel. +(44)161 833 0036

Fax. +(44)161 834 4688

E-mail: sales@cussons.co.uk Web: www.cussons.co.uk

The Company may alter detail specifications at its discretion and without notice, in line with its policy of continuous development.