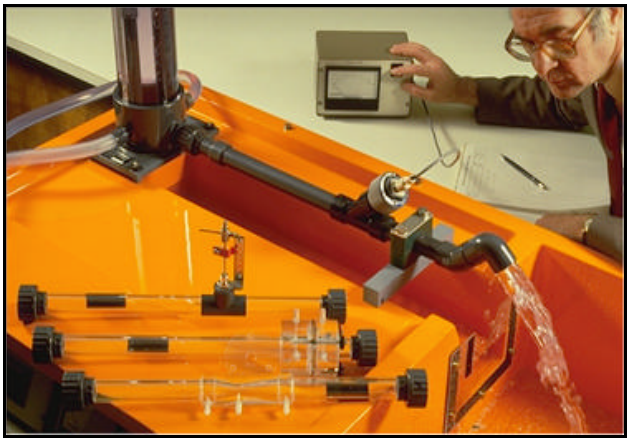
cussons
TECHNOLOGY



P6227/28/29/30

WATER FLOW MEASUREMENT

INTRODUCTION

The measurement of flow rate is a fundamental topic to which a considerable degree of attention has been paid with the result that there are flow meters available using a wide variety of principles. Cussons have chosen five types of flowmeter, which are all in common industrial use, to provide experiments in comparative flow measurement. Four flowmeters are described below which operate on the principle of either head loss, impulse or velocity.

A fifth flowmeter, P6108 Rotameter working on the variable area principle, is described separately in the Hydraulics Bench leaflet.

EXPERIMENTAL CAPABILITIES

- Demonstration of use of Venturi Tube as a water flow meter and determination of the flow coefficient.
- Establishment of the relationship that flow is proportional to the square root of the pressure drop between entry and the venturi throat.
- Observation of degree of pressure recovery at the end of the divergent section of the Venturi Tube.

DIMENSIONS AND WEIGHTS

Nett:- 75 x 75 x 500 mm, 1.0 Kg.
Gross:- 0.004m³, 2.0 Kg.

P6227 VENTURI METER

Cussons P6227 Venturi Meter which uses the head loss principle, is designed to be used on the Hydraulics Bench mounted between the P6103 Constant Head Inlet Tank and the P6104 Variable Head Outlet Tank. The P6106 Manometer Board is required for pressure measurement. The Feedblock P6105 may be used instead of the inlet head tank to increase the flow range.

The Venturi, which is manufactured from transparent acrylic material follows the classic 21° - 10° convergent-divergent design which forms the basis of most engineering standards for venturi flow meters. The P6227 Venturi Meter complies with the British Standard BS1042 for flow measurement. The dimensions of the Venturi Meter are shown in Fig 1. The upstream and throat pressure tappings are used for flow measurement whilst the downstream tapping allows an assessment of the pressure recovery to be made. The throat diameter is 11 mm and the upstream and downstream pipe diameters are both 21 mm.

The Venturi Meter test section is illustrated as item 2 in the accompanying photograph.

ACCESSORIES REQUIRED

P6103 Constant Head Inlet Tank
P6104 Variable Head Outlet Tank
P6105 Feedblock (to increase experimental range covered) - optional
P6106 Manometer Board
P6108 Rotameter (where direct flow readout is required) - optional
P6102 Pump Speed Display (optional)

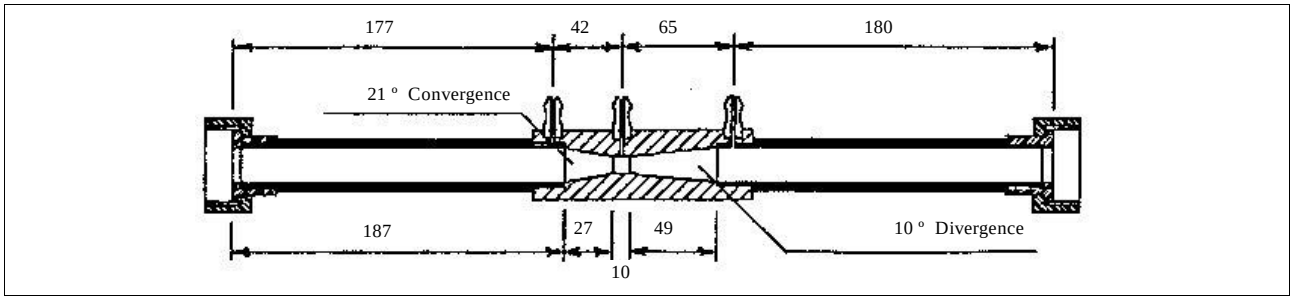


FIG. 1

P6228 ORIFICE FLOWMETER

Cussons P6228 Orifice Flowmeter which uses the head loss principle, consists of a 22 mm bore acrylic tube with two interchangeable sharp edged orifice plates of 8 mm and 12 mm bore. The downstream bore of each orifice is chamfered at 40° to provide an effective orifice plate thickness of 0.35 mm. The remaining dimensions are shown in Figure 2. The flanges of the orifice meter have been specially designed to incorporate corner tappings immediately adjacent to the orifice plate by the use of piezometer rings machined directly into the face of the flanges. The flanges also incorporate D and D/2 tappings. The design of the orifice plates conform with the British Standard for flow measurement BS1042.

The orifice plate flowmeters are designed for use between the P6103 Constant Head Inlet Tank and the P6104 Variable Head Outlet Tank. The P6106 Manometer Board is required for flow measurement and P6105 Feedblock may be used instead of the inlet tank to increase the flow range.

The orifice plate test section is illustrated as item 4 in the accompanying photograph.

EXPERIMENTAL CAPABILITIES

- Demonstration of use of Orifice Plate as a water flow meter and determination of the flow coefficient.
- Establishment of the relationship that flow is proportional to the square root of the pressure drop across the orifice plate.

ACCESSORIES REQUIRED

P6103 Constant Head Inlet Tank

P6104 Variable Head Outlet Tank

P6105 Feedblock (to increase experimental range covered) -optional

P6106 Manometer Board

P6108 Rotameter (where direct flow readout is required) -optional

P6102 Pump Speed Display (optional)

DIMENSIONS AND WEIGHTS

Nett:- 110 x 110 x 500 mm, 1.5 Kg.
Gross:- 0.009m³, 3.0Kg.

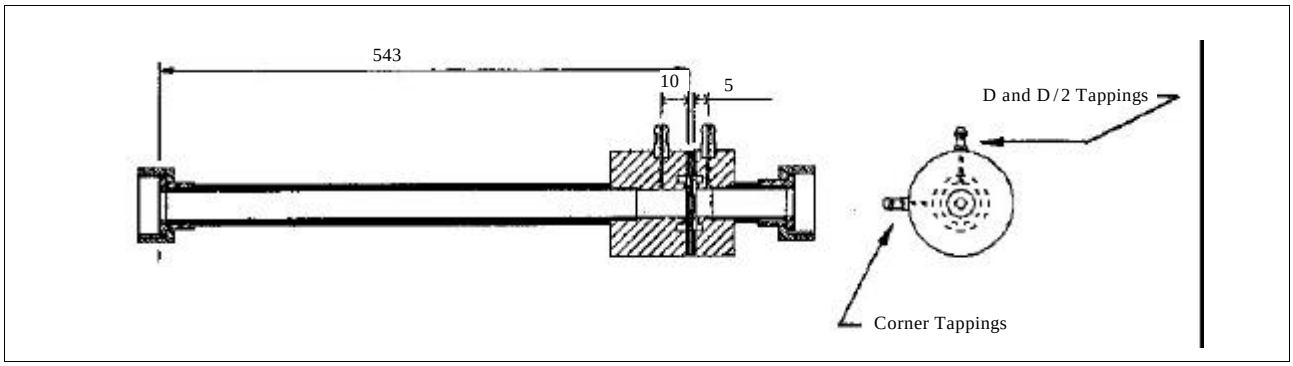
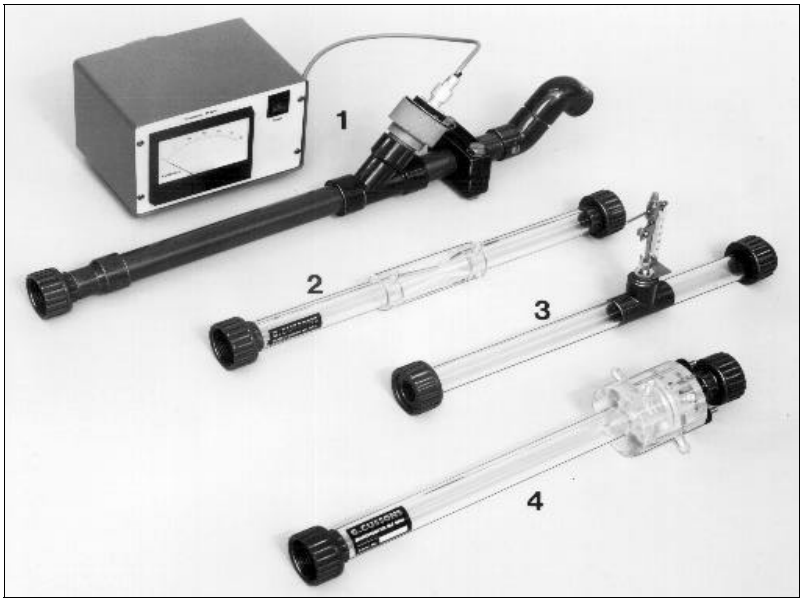


FIG. 2

1. P6229 TURBINE METER
2. P6227 VENTURI METER
3. P6230 PITOT TUBE
4. P6228 ORIFICE PLACE



P6229 TURBINE METER

Cussons P6229 Turbine Meter which uses the impulse principle, utilises a proprietary pulse producing turbine transducer mounted in a 29 mm bore acrylic tube and intended for connecting to either the P6103 Constant Head Inlet Tank or the P6105 Feedblock.

The main leg of the body of the turbine transducer unit (as shown in Fig. 3) forms part of the actual liquid flow line and the section at 90° to it houses the rotor bearings, variable inductance pickett coil and output electrical connections. A suitably positioned 'O' ring ensures that only the rotor blades and a small section of the rotor are in contact with the liquid, whose flow is to be measured. The clearances between rotor blades and outer casing are sufficiently large to enable particles in suspension in the liquid to pass through the body of the meter without difficulty.

As the rotor turns, the Pickett coil mounted on the flowmeter senses the passage of the rotor blades and emits a sine wave pulse. Hence the total number of pulses from the Pickett coil is a measure of the total quantity of fluid passing through the main leg, whilst the pulse rate is a measure of the liquid flow rate.

These pulses are fed to a frequency to voltage circuit and then to a moving coil meter providing an analogue readout of the transducer frequency output in Hertz.

The turbine meter test section is illustrated as item 1 on the accompanying photograph.

EXPERIMENTAL CAPABILITIES

- Calibration of the Turbine Meter using the volumetric tank on the Hydraulics Bench.
- Determination of reliability and reproducibility of results obtained from the Turbine Meter.

ACCESSORIES REQUIRED

P6103 Constant Head Inlet Tank

P6108 Rotameter (where direct flow readout is required)- optional

P6102 Pump Speed Display (optional)

DIMENSIONS AND WEIGHTS

Nett:- 210 x 150 x 500 mm, 7.5 Kg.
Gross:- 0.02m³, 9.0 Kg.

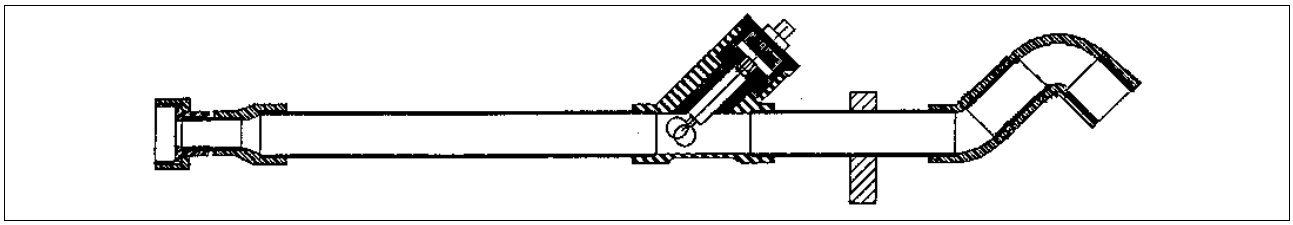


FIG. 3

P6230 PITOT STATIC TUBE

Cussons P6230 Pitot Static Tube which uses the velocity principle, comprises a 20 mm bore acrylic tube with a 2.3 mm diameter pitot static tube with a modified NPL elliptical nose. The pitot static tube is mounted in a central tee piece, and is arranged (as shown in Fig. 4) so that it can be traversed across a single diameter of the tube to allow the velocity profile across the tube to be determined. The whole assembly can be rotated to any angle to allow traverses to be conducted across other diametral planes.

The assembly is designed to be mounted between the P6103 Constant Head Inlet Tank and the P6104 Variable Head Outlet Tank. The P6106 Manometer Board is required for pressure measurement and the P6105 Feedblock may be used to extend the flow range.

The pitot static tube test section is illustrated as item 3 on the accompanying photograph.

EXPERIMENTAL CAPABILITIES

- Demonstration of the Tube flow coefficient and verification of the relationship that flow is proportional to the head difference between total head and static head.
- Determination of velocity profile.

ACCESSORIES REQUIRED

P6103 Constant Head Inlet Tank

P6104 Variable Head Outlet Tank

P6105 Feedblock (optional)

P6106 Manometer

P6108 Rotameter (optional)

P6102 Pump Speed Display (optional)

DIMENSIONS AND WEIGHTS

Nett:- 60 x 180 x 500 mm, 1.0 Kg.
Gross:- 0.008m^3, 2.0 Kg.

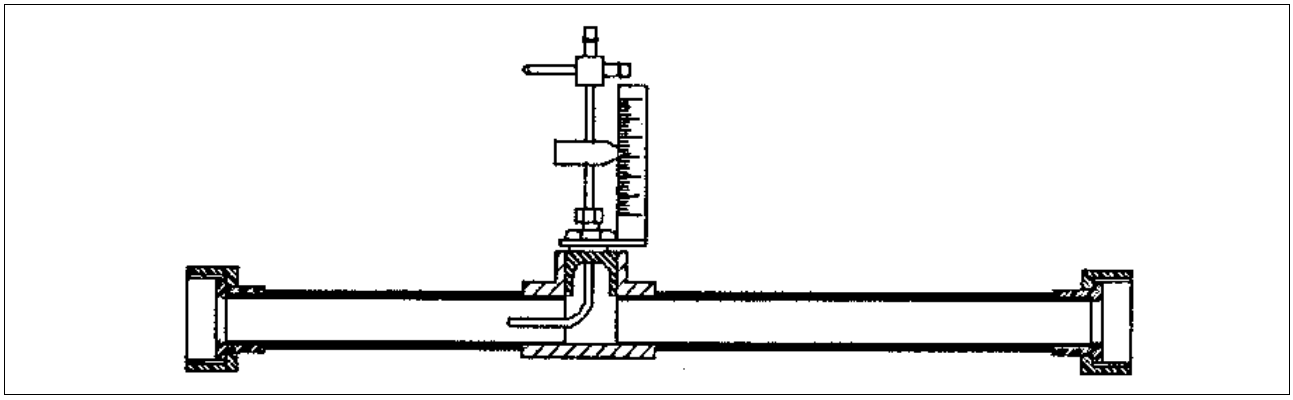


FIG. 4

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