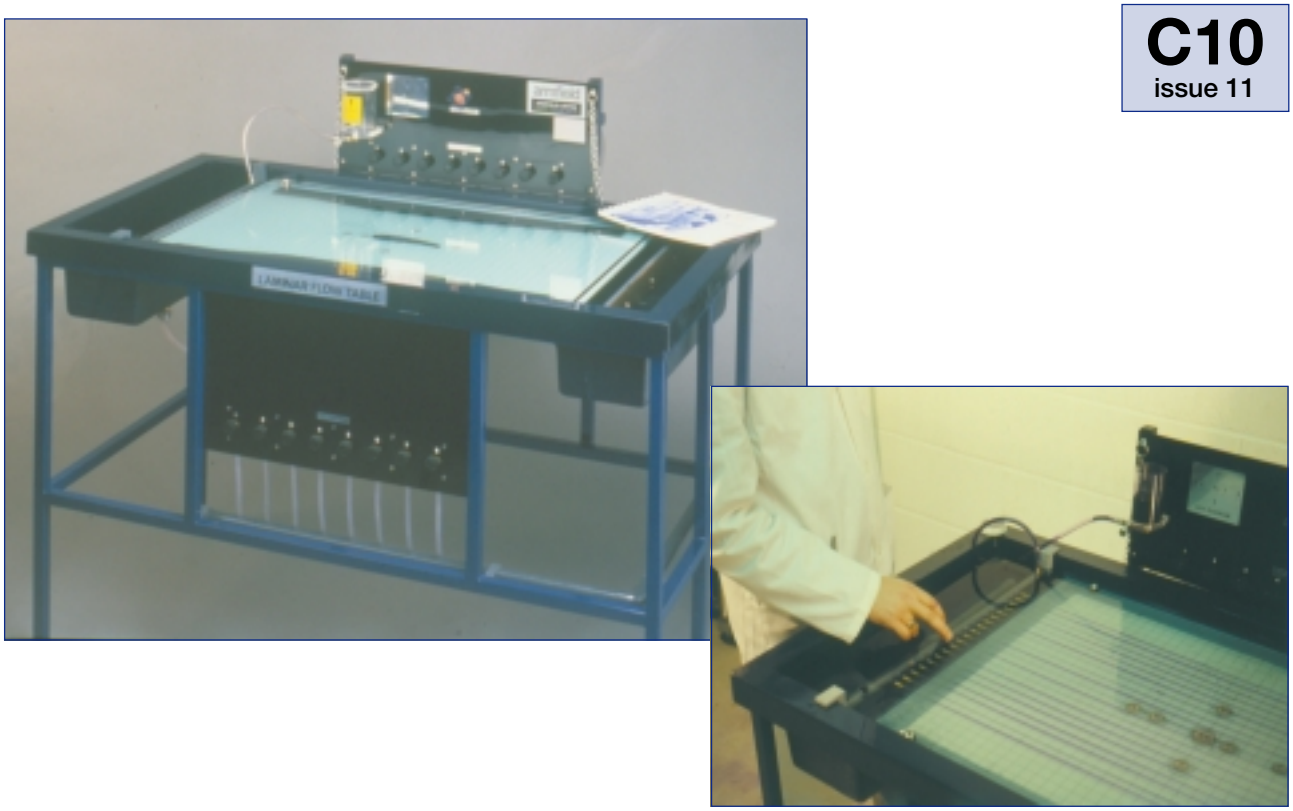
armfield

LAMINAR FLOW TABLE

C10
issue 11



The Armfield Laminar Flow Table has been designed to simulate ideal fluid flow and give clear visualisation of the flow patterns created using water as the working fluid. This enables a comprehensive investigation into the principles of potential flow and allows modelling of appropriate physical systems.

DEMONSTRATION CAPABILITIES

- *Ideal flow around immersed bodies*
  - *cylinder*
  - *aerofoil*
  - *bluff body.*
- *Ideal flow in channels and at boundaries*
  - *convergent channel*
  - *divergent channel*
  - *90 degree bend*
  - *sudden contraction*
  - *sudden enlargement*
  - *replacement of a streamline by a solid boundary.*
- *Ideal flow associated with sinks and sources*
  - *formation of a Rankine half body*
  - *formation of a Rankine oval*
  - *circular streamlines from a doublet*
  - *superposition of sinks and sources.*
- *Use of streamlines to analyse two-dimensional flow.*
- *Research - modelling two-dimensional systems.*

Applied Fluid Mechanics

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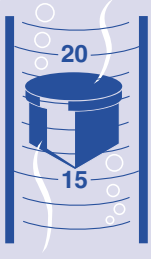
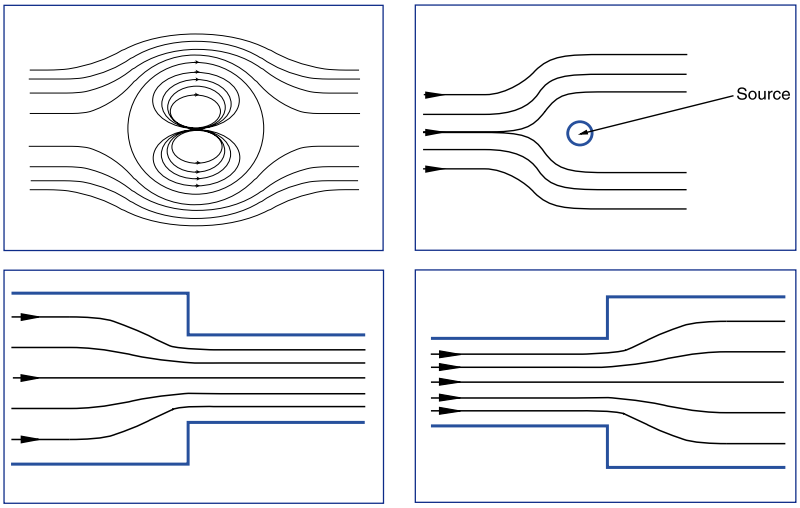


DESCRIPTION

The Laminar Flow Table is an improved version of the classical Hele-Shaw apparatus with the addition of sinks and sources. It consists of two closely spaced sheets of laminated glass, arranged horizontally on a glass fibre moulding. An inlet tank and discharge tank are incorporated in the moulding which is supported on a floor standing, metal frame. Three adjustable feet allow rapid levelling of the flow table.

Eight miniature tappings which may be used as sinks or sources are arranged about the centerline of the lower glass plate in a cruciform configuration. A doublet (a sink and source in close proximity) is located at the centre of the pattern. A system of pipes, valves and manifolds enables any combination of the sinks and sources to be used. A row of control valves mounted above the flow table is used to adjust the flow through each individual source. A row of control valves is used to adjust the flow through each individual sink.

These models are manufactured from plastic sheet and are trapped in the required position when the top glass plate is lowered. Alternative models can be fabricated from any convenient material and used to investigate the associated flow patterns.



Diagrams:

Top: *Streamline pattern for a doublet combined with a uniform stream*
Streamline pattern for a source combined with a uniform stream

Bottom: *Streamline pattern for a sudden contraction*
Streamline pattern for a sudden enlargement.

A row of hypodermic needles attached to a manifold is positioned between the glass plates at the inlet edge. To visualise the flow of water between the glass plates, dye is injected through the equally spaced needles. The position of each streamline is clearly indicated by the dye which is supplied from a reservoir fitted with a flow control valve. A black graticule on a white background is printed on the underside of the lower glass plate to aid visualisation of the streamlines.

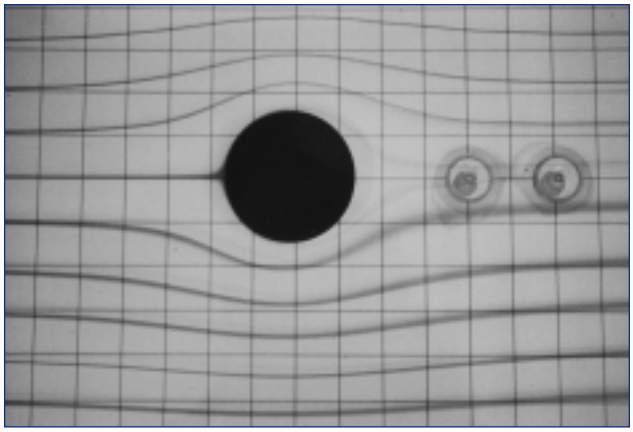
The patterns created by the potential flow may be recorded by tracing on the top glass sheet or by photography if required.

A diffuser in the inlet tank and an adjustable weir plate in the discharge tank help to promote a uniform flow of water. Valves are incorporated in the base of these tanks to aid draining. The flow of water is controlled by an inlet flow control valve. A bypass valve allows excess pressure from the mains water supply to be relieved.

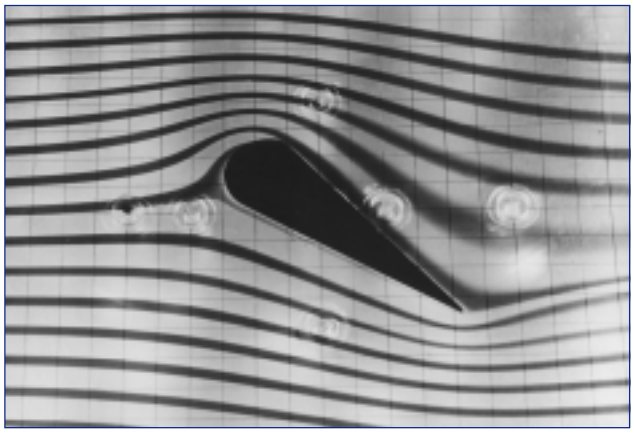
The top glass plate may be raised at the front edge and retained in this position to allow models to be placed in the working section. A set of models are supplied for basic flow studies.

Two-dimensional laminar flow is created between the two glass plates by the combination of low fluid velocity and the narrow gap between the plates. The resulting flow is free from turbulence and gives a close approximation to the behaviour of an ideal fluid. Since the flow is controlled by potential, the flow table can be used to model any physical system which obeys Laplace's Law. For example, two-dimensional steady heat flow through conductor of varying cross section can be simulated. In this instance the heat flow is represented by the flow of water and the temperature difference in the system is represented by the fluid pressure potential.

Similarly, the sinks and sources may be used in combination with the flow of water between the plates to simulate a variety of flow situations. For example, the patterns of flow in the vicinity of wells which draw water from underground supplies (aquifers) may be represented using one or more of the tappings as sinks. The effect of recharging the underground supply may be represented by utilising one or more of the tappings as sources.



Experiment in progress showing ideal flow around a cylinder



Experiment in progress showing ideal flow around an aerofoil

TECHNICAL DETAILS

Working section:

Width inside moulding: 606mm

Length of glass plates: 892mm

Distance between glass plates: 3.2mm

Sinks/sources: 8 tappings in 7 positions

Dye injectors: 19 hypodermic needles

Models supplied:

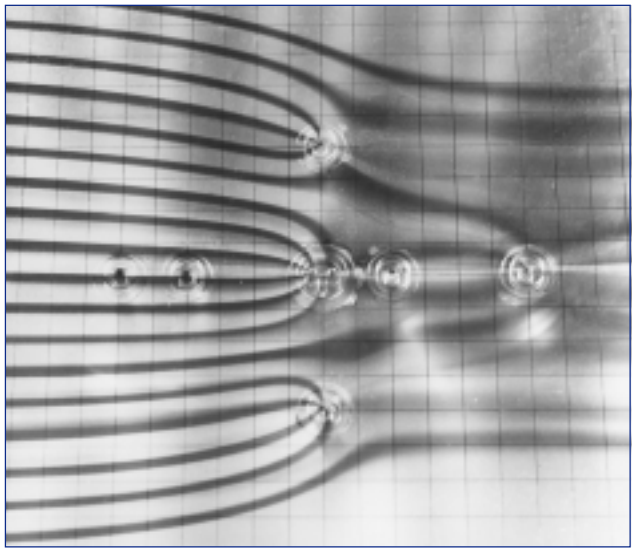
2 x canal banks

2 x rectangles

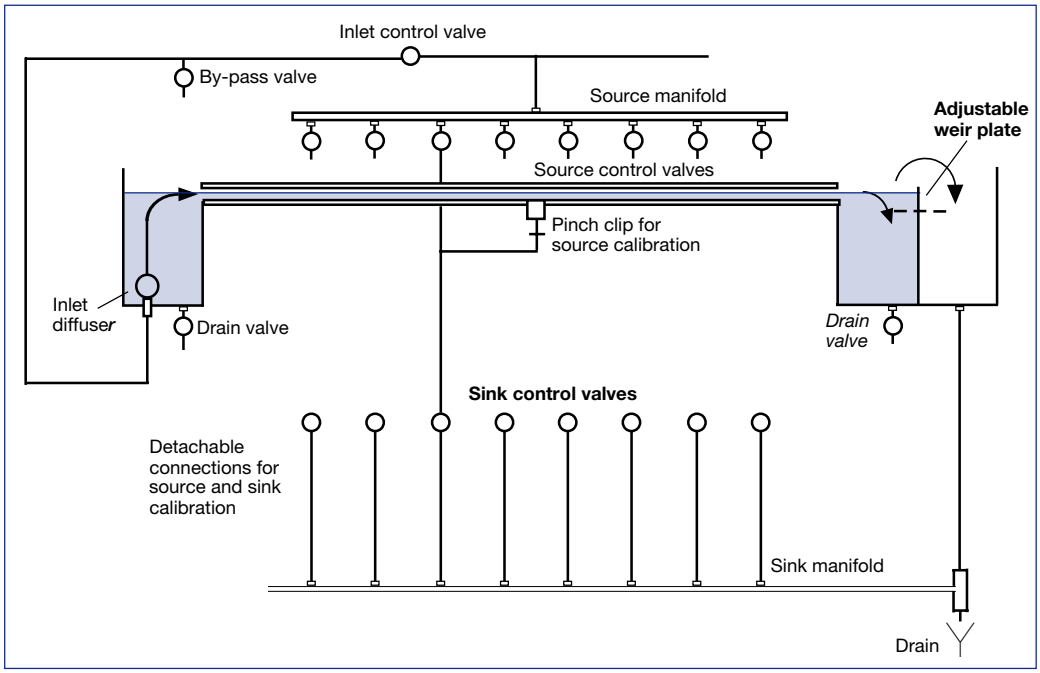
3 x cylinders

1 x aerofoil

3 gm of blue dye powder also supplied. (Makes 1 litre of dye solution when added to water)



Experiment in progress showing two sinks combined with a uniform stream



Schematic diagram showing pipework for one sink and source

ORDERING SPECIFICATION

- ***Floor standing apparatus demonstrates ideal flow, and Hele Shaw principles and is able to accept student made models.***
- ***Working section and end tanks made of glass reinforced plastic.***
- ***Working section dimensions 606mm x 892mm. Actual viewing area 495mm x 755mm.***
- ***Lower glass plate incorporates 8 sinks/sources in cruciform pattern and viewing graticule.***
- ***A system of pipes, valves and manifolds enables any configuration of sinks and sources to be used.***
- ***Includes dye injection system and adjustable knife edge weir for rapid, accurate adjustment of table flow.***
- ***Comprehensive instruction manual with illustrations.***
- ***Experimental capabilities:***
  - ***Ideal flow around immersed bodies - cylinder, aerofoil, bluff body***
  - ***Ideal flow in channels and at boundaries - convergent channel, divergent channel, 90 degree bend, sudden contraction, sudden enlargement, replacement of a streamline by a solid boundary***
  - ***Ideal flow associated with sinks and sources - formation of Rankine half body, formation of a Rankine oval, circular streamlines from a doublet, superposition of sinks and sources***
  - ***Use of streamlines to analyse two-dimensional flow***
  - ***Research - modelling two-dimensional systems***

SERVICES REQUIRED

Water supply:

0.25 litres/sec at 2 bar (abs)

Drain:

Suitable for water containing dye

OVERALL DIMENSIONS

Height:	*1.15m*
Width:	*1.32m*
Depth:	*0.78m*

SHIPPING SPECIFICATION

Volume:	*2.0m^3*
Gross weight:	*230kg*

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