

FLUID MECHANICS

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We are extremely satisfied with the TecEquipment Fluids and Thermodynamics equipment: it is well presented, works well and the students are able to operate it easily. The best feature is that the user guides are of a very high quality, with excellent theory sections and experiment guides. The support from TecEquipment introducing the equipment and installing it has been excellent too.

RICHARD ALBANY-WARD
SCHOOL OF SCIENCE AND TECHNOLOGY, UNIVERSITY OF NORTHAMPTON

FLUID MECHANICS

The Fluid Mechanics range offers a wide scope of teaching equipment for the delivery of complete courses in fluid dynamics.

BASE UNIT AND MODULES FOR FLEXIBILITY

In many settings, the modular Digital Hydraulic Bench (H1F) acts as a base unit, allowing tutors to swap out individually mounted experiment modules on these self-contained benches, reducing laboratory set-up time, space requirements, the need to be near a water source and cost. Modules include experiments for exploring Bernoulli's theorem, the function and dynamics of weirs, pressure and flow measurement, pipe friction and energy loss, and much more.

UNDERSTANDING FLOW

The impressive flow and sediment channels, for demonstrating the mechanics of flow, also enable the practical teaching and demonstration of phenomena such as critical and sub critical flow, hydraulic jump, and dune formation. There are many ancillaries available for use with the flow channels, enabling them to be used as both teaching and research aids.



PITOT TUBE FOR THE FC80 FLUME

KEY FEATURES AND BENEFITS:

LONGEVITY: Long-lasting equipment to teach principles that do not go out of date.

WATER AND SPACE SAVING: Many experiments work with the self-contained, mobile hydraulic bench to save water and laboratory space.

LARGE CHOICE OF EXPERIMENTS: A huge range of experiments for a complete course in fluid mechanics, from simple flow and pressure measurements to advanced studies of vortices and open-channel flow.

MODULAR FLUID POWER RANGE

The Fluid Mechanics range includes a sub-section of Modular Fluid Power products (**PAGES 134-148**) to demonstrate real-world applications of fluid mechanics. They include pumps and turbines, which also provide a link to renewable energy.

AUTOMATIC DATA ACQUISITION **VDAS**[®]

Each product in this range works with TecQuipment's unique Versatile Data Acquisition System (VDAS[®]) – **SEE PAGE 299.**



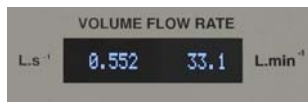
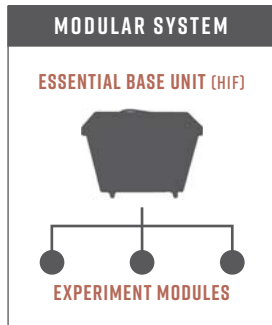
SPILLWAY FOR THE FC300 FLUME

DIGITAL HYDRAULIC BENCH

HIF

Provides a controlled recirculating water supply and accurate flowmeter for hydraulic and fluid mechanics experiments.

*UPGRADE YOUR OLDER GENERATION GRAVIMETRIC OR HYDRAULIC BENCH WITH A: **DIGITAL ELECTRONIC MEASURING KIT HIX**
SEE PAGE 105



DIGITAL FLOW DISPLAY



DIGITAL HYDRAULIC BENCH

FEATURES:	BENEFITS:
Supplies and measures water flow to over 15 different experiment modules	→ Saves space and reduces costs
Electronic flowmeter and digital display	→ Accurate measurements and quicker experiments
Self-contained with recirculating water circuit	→ Needs no external water supply, saves mains water
Fully mobile unit with a flat top to hold several experiment modules	→ Makes best use of laboratory space
Fibreglass construction	→ Strength, easier transport and long life

This product supplies a controlled flow of water to a wide variety of laboratory experiment modules (available separately). The body of the bench forms a reservoir or 'sump tank' with a submersible pump. Once filled, the bench needs no external water supply.

AVAILABLE EXPERIMENT MODULES:

BENCH-MOUNTED:

Flow Visualisation (FC15)	92
Flow Through an Orifice (H4)	104
Bernoulli's Theorem (H5)	94
Discharge Over a Notch (H6)	93
Friction Loss in a Pipe (H7)	99
Impact of a Jet (H8)	105
Flow Measurement Methods (H10)	95
Vortex Apparatus (H13)	107
Francis Turbine (H18)	126
Pelton Turbine (H19)	127
Hydraulic Ram Pump (H31)	128
Jet Trajectory and Orifice Flow (H33)	106
Pipework Energy Losses (H34)	101
Flow Meter Calibration (H40)	97



THE DIGITAL HYDRAULIC BENCH SHOWN WITH THE JET TRAJECTORY AND ORIFICE FLOW (H33) EXPERIMENT MODULE

FREE-STANDING:

Losses in Piping Systems (H16)	100
2.5-Metre Flow Channel (FC50-2.5)	114
Pipe Surge And Water Hammer (H405)	110
Fluid Friction Apparatus (H408)	102

FLUID MECHANICS

*Currently available only in the UK

FLOW VISUALISATION NEW

FG15

A compact, entry-level piece of equipment for visualising flow patterns around weirs and other objects in an open channel. A range of models supplied in the package makes this an ideal product for introducing students to flow visualisation in fluid mechanics.

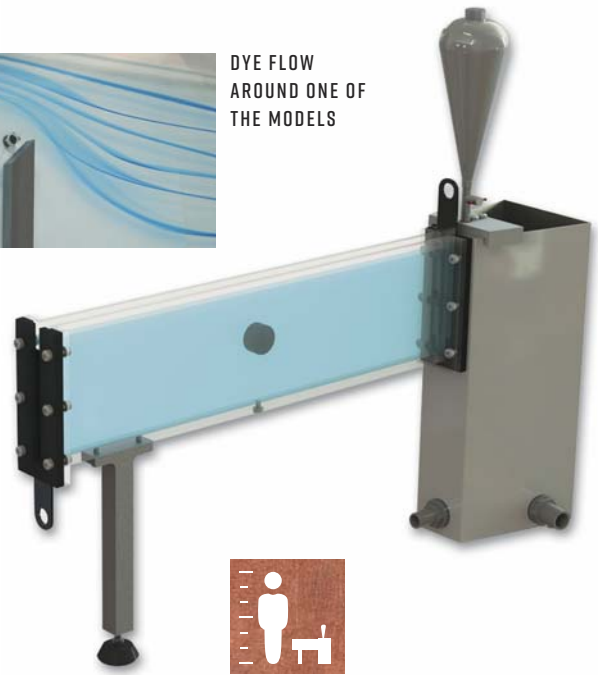
- Blank panel enhances visualisation by providing a plain backdrop
- Undershot inlet for demonstrating hydraulic jump
- Overshot outlet for regulating free surface height at low Reynolds numbers.

LEARNING OUTCOMES:

- Visualisation of flow around objects in an open channel
- Study of flow around submerged sharp-crested weir
- Study of a broad-crested weir and the effects of changing the profile of the weir (by reversing the block in the channel)
- Visualisation of flow around a hydrofoil (symmetrical and asymmetrical)
- Visual demonstration of hydraulic jump



DYE FLOW AROUND ONE OF THE MODELS



Consists of a robust stainless steel tank (to reduce turbulence) flowing into a 15 mm wide flow channel fabricated from transparent acrylic, together with various gates, weirs and blocks. The channel is fitted with dye injectors enabling the detail of flow patterns to be easily demonstrated and observed.

RECOMMENDED ANCILLARIES:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

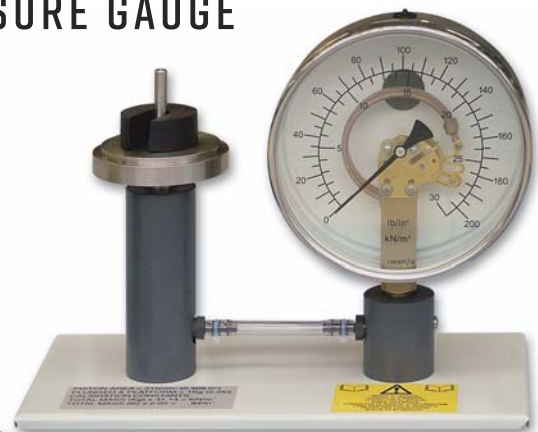
- Hele-Shaw Apparatus (H9) 109

CALIBRATION OF A BOURDON PRESSURE GAUGE

H3A

Demonstrates how a Bourdon tube pressure gauge works and how to calibrate it.

- Demonstrates 'dead weight' calibration of a Bourdon gauge
- Bourdon gauge has transparent dial so students can see how it works
- Suitable for group demonstrations and student experiments
- Self-contained – needs no extra services



Many engineering applications use the Bourdon gauge. TecQuipment's Calibration of a Pressure Gauge experiment allows students to study Bourdon tube theory. They see the working mechanism, calibrate the gauge and compare theoretical results to experimental results.

ALTERNATIVE PRODUCTS:

- Pressure Measurement Bench (H30) 96
- Hydrostatics and Properties of Fluids (H314) 121

LEARNING OUTCOMES:

- Function, operation and calibration of a Bourdon tube pressure gauge

DISCHARGE OVER A NOTCH

H6

For the study of weirs as flow regulation and measurement devices.



- Portable, corrosion-resistant glass-fibre channel for ease of use and long life
- Includes one rectangular and two V-shaped notches for basic experiments
- Two additional weirs included for more advanced experiments
- Adjustable depth gauge for precise measurement of water level
- Works with TecQuipment's Digital Hydraulic Bench for easy installation

LEARNING OUTCOMES:

Comprehensive study of flow over weirs, including:

- Investigation of head against discharge
- Coefficient of discharge for notches
- Rectangular and different angled V-notches

The Discharge Over a Notch apparatus demonstrates clearly the use of weirs as simple flow regulators. It allows students to do tests on relationships between upstream water level and weir discharge for different shaped notches. They can then compare their results with theory.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Flow Channels 114–118



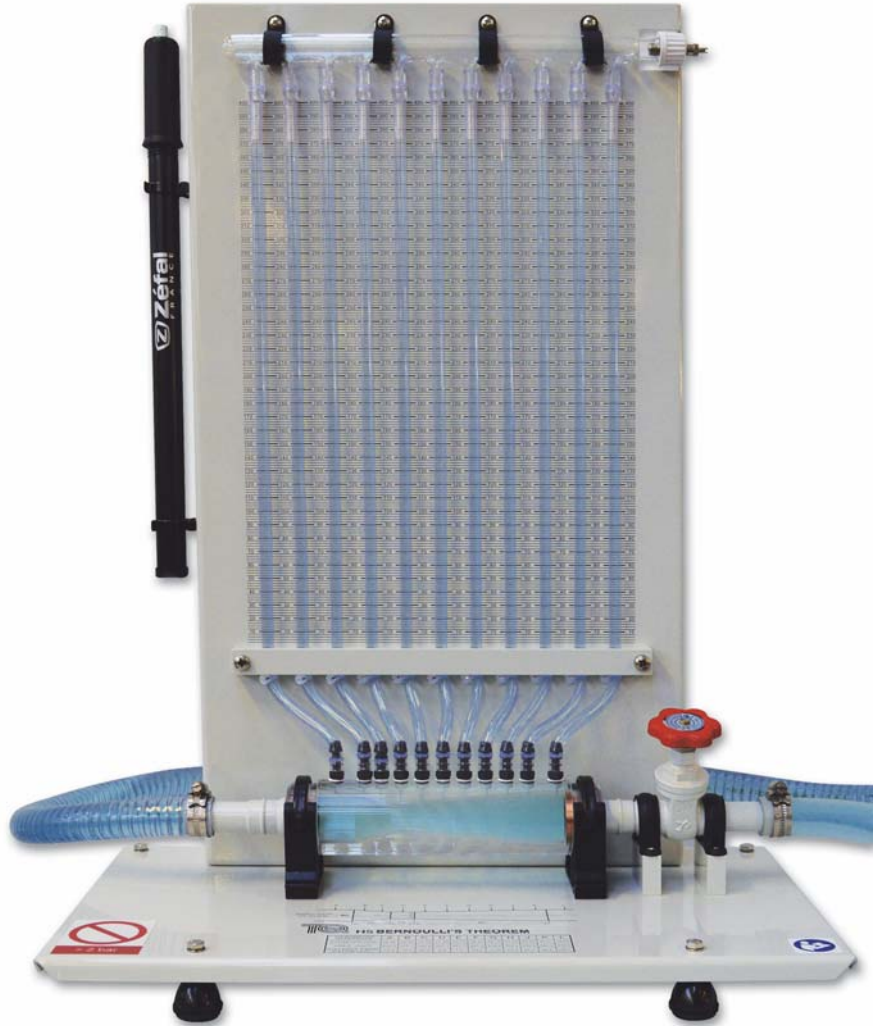
SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) – AVAILABLE SEPARATELY

BERNOULLI'S THEOREM

H5

Allows students to study Bernoulli's theorem by measuring the complete static head distribution along a horizontal Venturi tube.

- Eleven pressure tapings along the tube
- Direct measurement of static heads
- Complete pressure distribution clearly visible
- Compact and simple to operate
- Works with TecQuipment's Digital Hydraulic Bench for easy installation



LEARNING OUTCOMES:

Comprehensive study of a Venturi meter and Bernoulli's theorem, including:

- Direct measurement of the static head distribution along a Venturi tube
- Comparison of experimental results with theoretical predictions
- Measurement of the meter coefficient of discharge at various flow rates

The Venturi tube in TecQuipment's Bernoulli's Theorem is typical of meters used throughout industry. However, it has many more pressure tapings, connecting to water manometers, which allow full study of the pressure distribution along the convergent-divergent passage.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

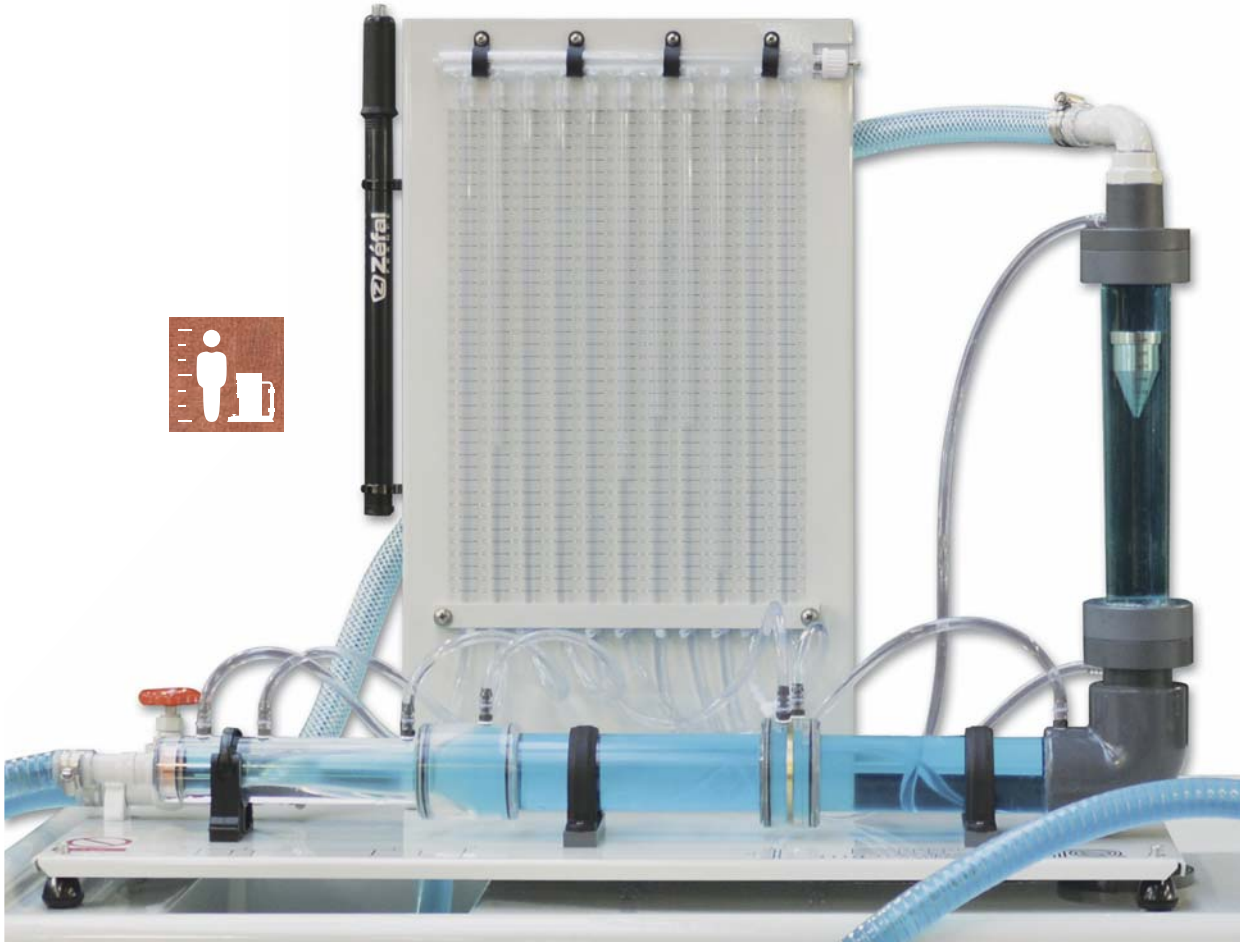
ALTERNATIVE PRODUCTS:

- Bernoulli's Equation (AF11) 32
- Flow Measurement Methods (H10) 95
- Flow Meter Calibration (H40) 97
- Fluid Friction Apparatus (H408) 102

FLOW MEASUREMENT METHODS

H10

Demonstrates typical methods of measuring the flow of an incompressible fluid and shows applications of Bernoulli's equation.



- Includes Venturi meter, orifice plate and rotameter
- Works with TecQuipment's Digital Hydraulic Bench for easy installation
- Direct measurement of head loss
- Three different flow meters which work with Bernoulli's equation
- Multi-tube manometer demonstrates pressure at various points

Students measure flow using a Venturi meter, an orifice plate meter and a rotameter. Students find and compare the head losses associated with each meter, as well as those arising in a rapid enlargement and a 90-degree elbow.

LEARNING OUTCOMES:

Study of Bernoulli's equation, flow measurement and losses, including:

- Application of the Bernoulli equation for incompressible fluids
- Direct comparison of flow measurement using a Venturi meter, orifice plate and rotameter
- Comparison of pressure drops across each flow-measurement device
- Comparison of pressure drops across a sudden enlargement and a 90-degree elbow

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Bernoulli's Theorem (H5) 94
- Flow Meter Calibration (H40) 97
- Fluid Friction Apparatus (H408) 102

PRESSURE MEASUREMENT BENCH

H30

Self contained, bench-mounted apparatus that enables a range of practical investigations into manometer and Bourdon gauge pressure measurement techniques, including inclined and U-tube manometers, and Bourdon-type vacuum and pressure gauges.



- Provides practical investigations for pressure measurement using inclined and U-tube manometers, and Bourdon-type vacuum and pressure gauges
- Enables instant comparison of measurement methods
- Includes separate Bourdon gauge with dead-weight calibration apparatus, and Bourdon tube mechanism clearly visible
- Fully self-contained, bench-top apparatus
- Suitable for group demonstrations and individual student experiments

LEARNING OUTCOMES:

A range of investigations into common pressure-measurement techniques, including:

- Comparison of pressure measurement by manometer and Bourdon gauge
- Calibration of a pressure gauge
- Determination of gauge errors as a function of true pressure

The apparatus consists of two units: a manometers and gauges unit, and a Bourdon pressure gauge calibration unit.

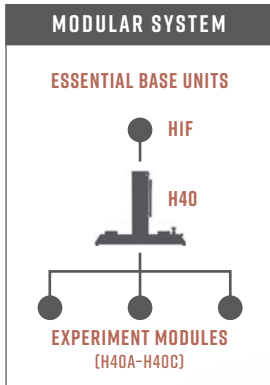
ALTERNATIVE PRODUCTS:

- Calibration of a Bourdon Pressure Gauge (H3a) 92
- Hydrostatics and Properties of Fluids (H314) 121

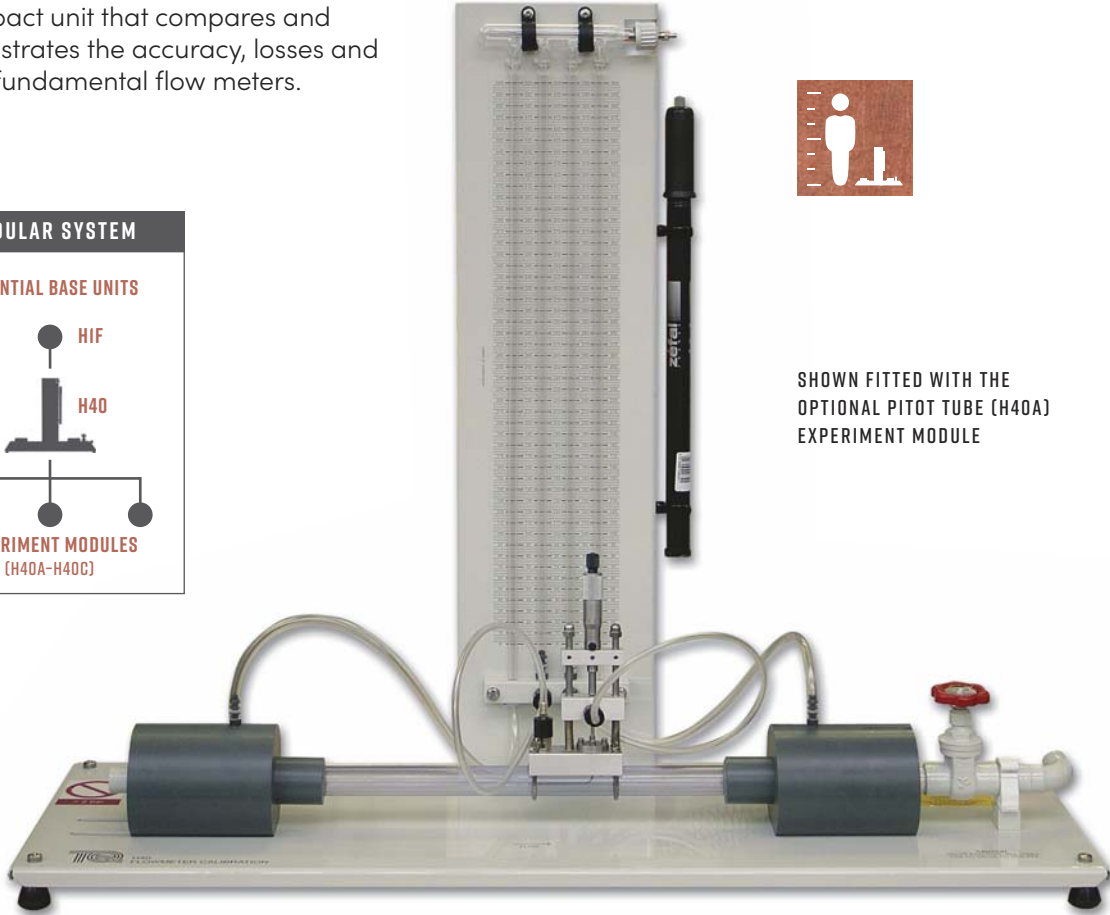
FLOW METER CALIBRATION

H40

A compact unit that compares and demonstrates the accuracy, losses and use of fundamental flow meters.



SHOWN FITTED WITH THE OPTIONAL PITOT TUBE (H40A) EXPERIMENT MODULE



FEATURES:

Supports and measures pressures in its optional experiment modules

Nozzle flow meter included as standard

Optional Pitot, Venturi and orifice flow meters

Unique 'quick-change' adaptors and self-sealing pressure connections

Works with TecEquipment's Digital Hydraulic Bench (H1F)

BENEFITS:

➔ Saves space and reduces costs

➔ Allows tests 'out of the box'

➔ For comparisons of accuracy, losses, and tests of velocity profile and boundary layer effect

➔ Maximises experiment time and reduces water spills

➔ Easy installation and accurate external flow measurement

LEARNING OUTCOMES:

- Accuracy of nozzle flow meters
- Losses and k_c value
- Calculation of the coefficient of discharge

The Flow Meter Calibration works with TecEquipment's Digital Hydraulic Bench (H1F, available separately) and stands on the hydraulic bench worktop. Four water-filled manometers show the pressure differences at the flow meter and across the overall flow meter assembly.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

AVAILABLE EXPERIMENT MODULES:

- Pitot Tube (H40a) 98
- Venturi Flow Meter (H40b) 98
- Orifice Flow Meter (H40c) 98

ALTERNATIVE PRODUCTS:

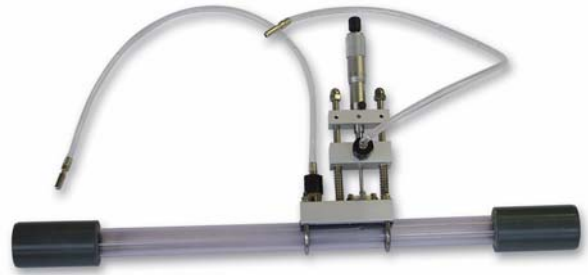
- Bernoulli's Theorem (H5) 94
- Flow Measurement Methods (H10) 95
- Fluid Friction Apparatus (H408) 102

PITOT TUBE

H40A

Pitot tube flow meter for use with the Flow Meter Calibration unit (H40).

- Demonstrates the accuracy and use of a Pitot tube flow meter
- Demonstrates the boundary layer effect and the fluid velocity profile
- Micrometer head for precise adjustment



LEARNING OUTCOMES:

- Accuracy of Pitot tube flow meters
- Losses and k value
- Calculation of the coefficient of discharge
- Velocity profile

ESSENTIAL BASE UNIT:

- Flow Meter Calibration (H40) – with H1F 97

VENTURI FLOW METER

H40B

Venturi flow meter for use with the Flow Meter Calibration unit (H40).

- Demonstrates the accuracy and use of a Venturi flow meter
- Demonstrates how a flow constriction affects pressure
- ISO standard dimensions for more predictable results



ESSENTIAL BASE UNIT:

- Flow Meter Calibration (H40) – with H1F 97

LEARNING OUTCOMES:

- Accuracy of Venturi flow meters
- Losses and k value
- Calculation of the coefficient of discharge

ORIFICE FLOW METER

H40C

Sharp-edged orifice flow meter for use with the Flow Meter Calibration unit (H40).

- Demonstrates the accuracy and use of a sharp-edged orifice flow meter
- Demonstrates how an orifice affects pressure
- ISO standard dimensions for more predictable results



LEARNING OUTCOMES:

- Accuracy of orifice flow meters
- Losses and k value
- Calculation of the coefficient of discharge

ESSENTIAL BASE UNIT:

- Flow Meter Calibration (H40) – with H1F 97

FRICITION LOSS IN A PIPE

H7

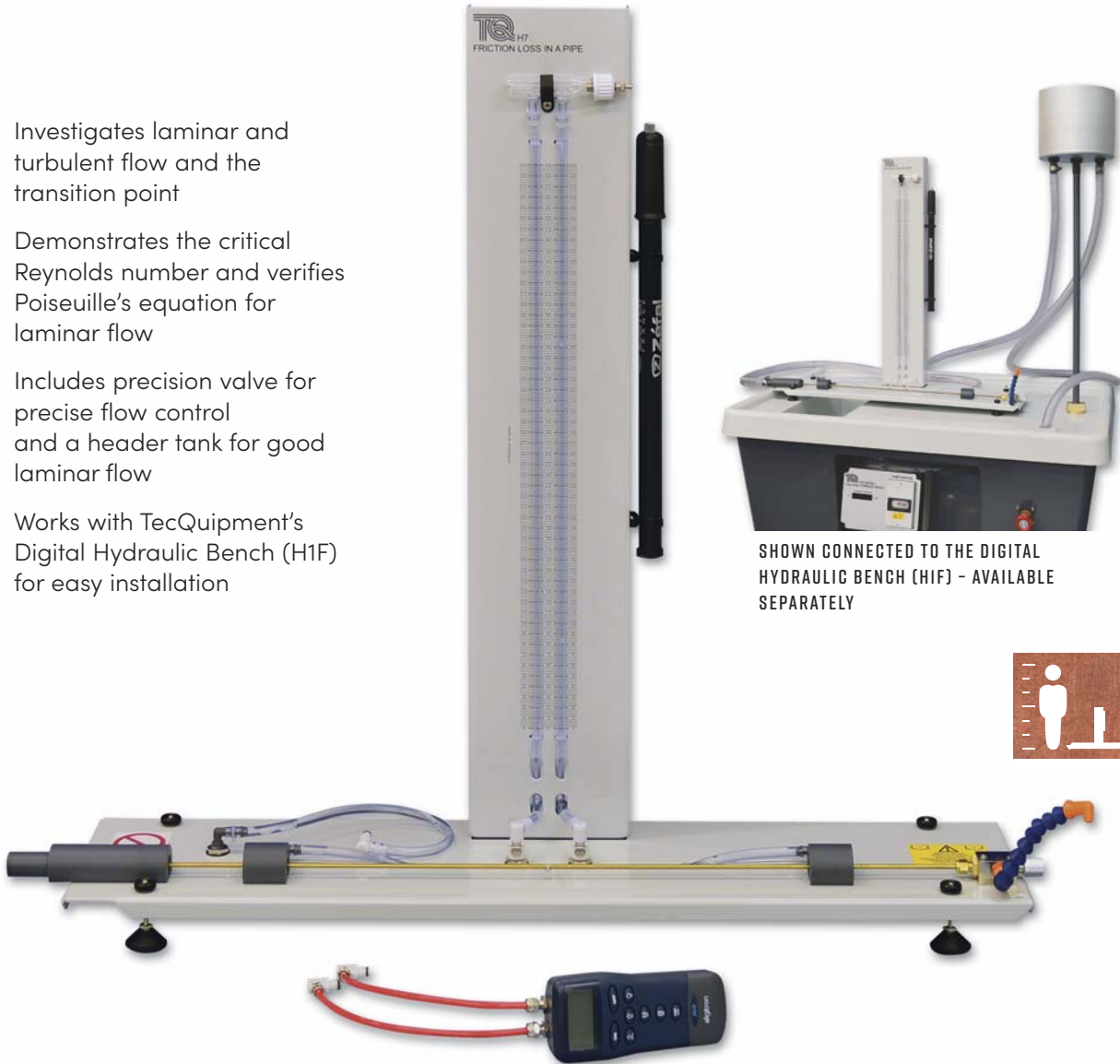
For direct measurement of friction loss in a small-bore horizontal pipe to study the change in the laws of resistance for laminar and turbulent flow, find the critical Reynolds number and demonstrate the flow transition point.

*UPGRADE OLDER GENERATIONS OF THIS EQUIPMENT WITH A: **DIGITAL ELECTRONIC MEASURING KIT H7X**
SEE PAGE III

- Investigates laminar and turbulent flow and the transition point
- Demonstrates the critical Reynolds number and verifies Poiseuille's equation for laminar flow
- Includes precision valve for precise flow control and a header tank for good laminar flow
- Works with TecQuipment's Digital Hydraulic Bench (H1F) for easy installation



SHOWN CONNECTED TO THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY



LEARNING OUTCOMES:

Study of friction loss in a pipe, including:

- Investigations of laminar and turbulent flows
- Demonstration and measurement in the change of the laws of resistance (friction factor) from laminar to turbulent flow
- Finding the critical Reynolds number
- Verifying Poiseuille's equation and the coefficient of viscosity for water in the laminar flow region

The equipment is a small-bore straight test pipe on a base plate. It works with the Digital Hydraulic Bench (H1F, available separately) and stands on the bench worktop.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Losses in Piping Systems (H16) 100
- Fluid Friction Apparatus (H408) 102
- Osborne-Reynolds Apparatus (H215) 103
- Pipework Energy Losses (H34) 101

LOSSES IN PIPING SYSTEMS

H16

Freestanding apparatus, demonstrates pressure losses in several small-bore pipe circuit components, typical of those found in central heating installations.

*UPGRADE OLDER GENERATIONS OF THIS EQUIPMENT WITH A: **DIGITAL ELECTRONIC MEASURING KIT H16X**
SEE PAGE III

PIPE FRICTION AND ENERGY LOSS

FLUID MECHANICS



- Includes two colour-coded water circuits
- Works with TecEquipment's Digital Hydraulic Bench for easy installation
- Includes different pipe bends and valves for students to compare losses
- Fitted with a range of piezometers and a pressure gauge to give accurate pressure measurement
- Optional 'roughened pipe' ancillary to investigate flow characteristics in a roughened pipe

The Losses in Piping Systems apparatus comprises a vertical panel with two separate hydraulic circuits, colour-coded for clarity. Each circuit includes various pipe system components. The unit has wheels for mobility.

LEARNING OUTCOMES:

A comprehensive range of investigations into losses in a variety of pipes and pipe system components, including:

- Straight pipe loss
- Sudden expansion
- Sudden contraction
- Bends with different radii
- Valves
- Elbows
- Flow in a roughened pipe – needs the optional Roughened Pipe (H16p)

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

RECOMMENDED ANCILLARIES:

- Roughened Pipe (H16p)

ALTERNATIVE PRODUCTS:

- Friction Loss in a Pipe (H7) 99
- Pipework Energy Losses (H34) 101
- Fluid Friction Apparatus (H408) 102

PIPEWORK ENERGY LOSSES

H34

Compares pressure losses and k value of popular fittings in small-bore pipework.



- Compact, easy to fit and easy to use
- Includes three different bends: mitre, elbow and large radius
- Compares losses in a sudden enlargement (or expansion) and a contraction
- Includes a multi-tube piezometer for fundamental, accurate pressure measurements
- Works with TecEquipment's Digital Hydraulic Bench

LEARNING OUTCOMES:

Measurement and comparison of losses in:

- Mitre bend
- Elbow bend
- Large radius bend
- Sudden expansion
- Sudden contraction

This compact bench-top apparatus uses smooth, industry-standard plastic pipe, commonly used in domestic and other small-bore water systems.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Friction Loss in a Pipe (H7) 99
- Losses in Piping Systems (H16) 100
- Fluid Friction Apparatus (H408) 102

FLUID FRICTION APPARATUS

H408

Demonstrates flow and losses in different pipes, fittings and valves. Shows popular flow measurement instruments.



- A space-saving vertical panel that works with TecEquipment's Digital Hydraulic Bench for easy installation
- Includes experiments on roughened pipes
- Uses Bernoulli's equation
- Demonstrates how to use Venturi and orifice meters to measure flow
- Includes a traversing Pitot tube to measure the velocity profile

TecEquipment's Fluid Friction Apparatus allows students to study flow, flow measurement techniques and losses in a wide variety of pipes and fittings. The equipment has three water circuits with instruments, pipes and pipe system components.

LEARNING OUTCOMES:

- Use of the Pitot static tube
- Flow measurement using a Venturi meter and an orifice meter
- Smooth pipes
- Artificially roughened pipe
- Straight pipe loss
- Sudden expansion and contraction
- Bends and elbows
- Valves
- In-line strainer

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Losses in Piping System (H16) 100
- Pipework Energy Losses (H34) 101
- Flow Meter Calibration (H40) 97
- Flow Measurement Methods (H10) 95
- Bernoulli's Theorem (H5) 94
- Friction Loss in a Pipe (H7) 99

OSBORNE-REYNOLDS APPARATUS

H215

Free-standing apparatus that gives a visual demonstration of laminar and turbulent flow. It also allows students to investigate the effect of varying viscosity and investigate Reynolds numbers.

- Constant head reservoir and flow-smoothing parts for a smooth flow
- Uses dye injector system to demonstrate flow patterns
- Investigates Reynolds number at transition
- Optional heater module available for tests at different viscosities



DYE STREAM SHOWING LAMINAR FLOW



OPTIONAL HEATER MODULE (H215A)



LEARNING OUTCOMES:

- Demonstration of transition between laminar and turbulent flow
- Determination of transition Reynolds numbers and comparison with accepted values
- Investigation of the effect of varying viscosity, and demonstration that the Reynolds number at transition is independent of viscosity

The apparatus consists of a precision-bore glass pipe (test tube) held vertically in a large shroud. The shroud is open at the front and the inside surface is light coloured. This allows the students to see the flow clearly.

ESSENTIAL ANCILLARIES:

- Stopwatch (SW1) – To measure flow rates 28

RECOMMENDED ANCILLARIES:

- Heater Module (H215a) – Free-standing unit to vary and control the water temperature and hence its viscosity 103

ALTERNATIVE PRODUCTS:

- Friction Loss in a Pipe (H7) 99
- Viscosity and Particle Drag (H410) 122

FLOW THROUGH AN ORIFICE

H4

Demonstrates flow through different orifices for different flow rates.

- Direct measurement of total head, head loss and diameter of jet
- Vertical water jet
- Integral Pitot traverse tube
- Sharp-edged orifice included
- Works with TecEquipment's Digital Hydraulic Bench for easy installation



LEARNING OUTCOMES:

Investigations into a variety of orifices over a range of flow rates, including:

- Determination of contraction and velocity coefficients
- Calculation of discharge coefficient
- Determination of actual discharge coefficient, and comparison with calculated values
- Determination of the various coefficients over a range of flow rates to demonstrate the influence of Reynolds number
- Study of the characteristics of different orifices, using a set of four circular orifices (nozzles). Each has the same minimum throat diameter but a different length. Each has a different approach and discharge section. Also included are additional square and triangular orifices.



Water flows from the hydraulic bench and into the cylindrical tank through an adjustable diffuser. The flow rate and an overflow pipe set the water level. To change the level in the tank (and so the head on the orifice), students adjust the flow to the diffuser. Water leaves the tank through the orifice. The jet that leaves the orifice discharges back into the hydraulic bench. The equipment is supplied with a set of interchangeable orifices (nozzles).

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Jet Trajectory and Orifice Flow (H33) 106



SHOWN FITTED TO THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY

IMPACT OF A JET

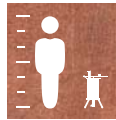
H8

Investigates the force generated by a jet striking plates (representing turbine vanes) to aid in the understanding of how turbines work.

- Includes flat and hemispherical plates
- Extra angled and conical plates
- Ideal for demonstrations as well as in-depth experiments
- Works with TecQuipment's Digital Hydraulic Bench for easy installation



120-DEGREE CONICAL PLATE AND 30-DEGREE ANGLED PLATE



LEARNING OUTCOMES:

Measurement of the impact force and comparison with momentum change of four different plates:

- Flat plate
- Hemispherical plate
- Inclined flat plate
- 120-degree conical plate
- 30-degree angled plate

The Impact of a Jet apparatus demonstrates the force produced by a jet of water as it strikes a flat plate or hemispherical cup, which can be compared to the momentum flow rate in the jet. To extend the range of investigations, the 120-degree conical plate and 30-degree angled plate are included.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Pelton Turbine (H19) 127
- Pelton Wheel (Turbine) (MFP101b) 137

UPGRADE YOUR HYDRAULIC BENCH

Using a TecQuipment Gravimetric or Volumetric Hydraulic Bench? It can now be upgraded to include an electronic flow measurement instrument, offering the convenience of the electronic flowmeter display currently found on the **DIGITAL HYDRAULIC BENCH** (H1F).

FEATURES:

- Instant display of flow rate in $\text{l}\cdot\text{min}^{-1}$ and $\text{l}\cdot\text{s}^{-1}$
- Comprehensive assembly instructions and drilling templates supplied

BENEFITS:

- Significant time savings for experiments: for example, save 25 minutes for Bernoulli's theorem (H5) experiment
- Purchase from maintenance budget

JET TRAJECTORY AND ORIFICE FLOW

H33

Demonstrates vertical flow and horizontal jet trajectory through different orifices (nozzles) and allows students to study the trajectory profiles of water jets from the nozzles when mounted horizontally.

- Determination of the contraction and velocity coefficients
- Calculation of the discharge coefficient
- Determination of the actual discharge coefficient by measurement of flow rate
- Demonstrates the influence of Reynolds number
- Determination of discharge characteristics (jet trajectory) for an orifice mounted in the side of a vertical tank

With this apparatus students can measure the decrease in flow, contraction of the stream and energy loss as water discharges from four vertically mounted, interchangeable nozzles with different orifice designs.

It works with the Digital Hydraulic Bench (H1F, available separately) and stands on the bench worktop.



SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY

LEARNING OUTCOMES:

- Determination of the contraction and velocity coefficients
- Calculation of the discharge coefficient
- Determination of the actual discharge coefficient by measurement of flow rate
- Demonstrates the influence of Reynolds number
- Determination of discharge characteristics (jet trajectory) for an orifice mounted in the side of a vertical tank

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Flow Through an Orifice (H4) 104

VORTEX APPARATUS

H13

Demonstrates the phenomena of free and fixed vortices with measuring devices for calculating the water surface profile.



SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY

- Transparent vessel – users can see the vortices from all angles
- Includes a traverse probe to measure water surface profile
- Low-voltage variable speed motor for safety
- Ideal for classroom demonstrations as well as laboratory experiments
- Works with TecQuipment's Digital Hydraulic Bench (H1F)

FULL SPECIFICATION DATASHEETS

Datasheets contain full specifications such as size, weight, noise output, fluid capacity, voltage requirements etc. Download from each individual product webpage.

TECQUIPMENT.COM (search product)

LEARNING OUTCOMES:

- Determination of the surface profile of a forced vortex
- Determination of the surface profile of a free vortex
- Determination of the total head variation in a forced vortex
- Comparison of results with theoretical predictions

A transparent vessel on a support frame mounts on a TecQuipment Digital Hydraulic Bench (H1F, available separately). A low-voltage, variable-speed motor rotates the vessel about its vertical axis and a speed-control unit controls the speed of rotation.

To produce a forced vortex, students add water to the rotating vessel until it is about half full. A forced vortex forms. After a few minutes the vortex becomes constant, and students can measure the surface profile using the traverse probe.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F)

91

CAVITATION IN A VENTURI

H400

A floor-standing, self-contained apparatus to demonstrate and observe the basic principles of cavitation and its implications on the performance of hydraulic machines and systems.

- Also allows practical and effective study of flow and pressure in a Venturi meter
- Ideal for classroom demonstrations and student experiments
- Fully self-contained recirculating apparatus – no additional water supply needed
- Includes full instrumentation, for pressure, flow and temperature measurement



CAVITATION IN THE VENTURI



LEARNING OUTCOMES:

Investigations into cavitation and the Venturi, including:

- Flow and pressure in the Venturi
- Demonstrations of cavitation
- How to predict the onset of cavitation
- Study of upstream and throat pressures

The apparatus is a self-contained, mobile unit. It consists of a robust frame which holds a water tank (or reservoir), an electric pump, a flow-control valve, a flow meter and a Venturi.

RECOMMENDED ANCILLARIES:

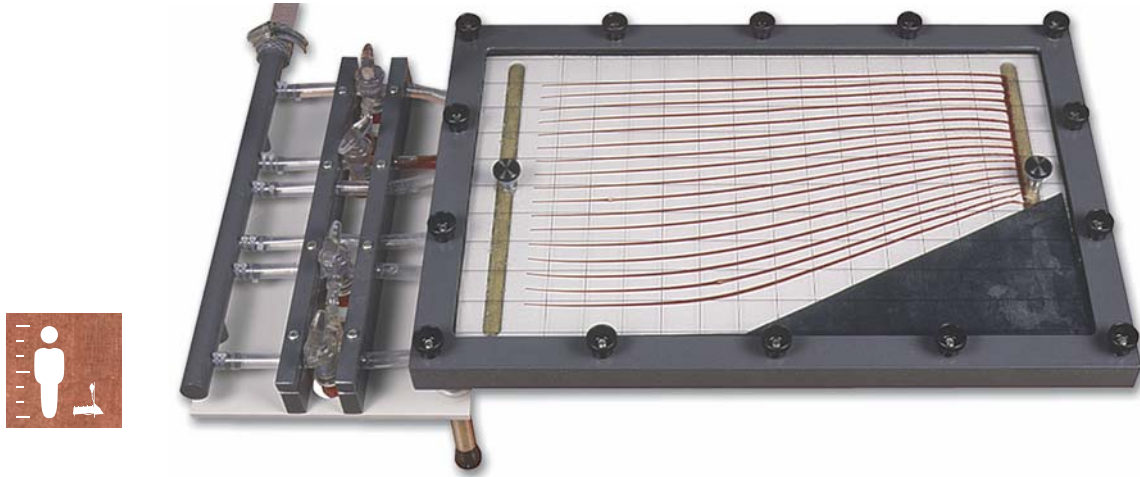
- Stroboscope (ST1)

303

HELE-SHAW APPARATUS

H9

A bench-mounted apparatus to demonstrate two-dimensional laminar flow around differently shaped models, allowing the study of various source and sink arrangements.



- Visually effective demonstration of a wide variety of flow patterns around different shapes
- Models easily cut from sheet (included) – almost any shape possible
- Ideal introduction to incompressible potential flow (aerodynamics)
- Source and sink points provided
- Can demonstrate soil seepage problems

The apparatus works with a steady, air-free water supply and suitable drain. It consists of a channel, formed between two plates, where water flows at a low Reynolds number. A dye flowing through several small holes at the upstream end produces streamlines. To perform experiments, students start the water flow and open a dye valve just enough to produce easily visible streamlines. They then use valves to allow water to flow from a source point or drain into a sink point, or various combinations of flow or sink points.

LEARNING OUTCOMES:

Various flow visualisation experiments in two dimensions, including sink and source points and flow around models, for example:

- Sources and sinks in a uniform stream
- Doublet in a uniform stream
- Flow around a cylinder (disc) and an aerofoil
- Flow through an orifice and a diffuser
- Flow through a heat exchanger
- The momentum equation
- Laminar flow relationship for flow between two parallel plates
- Mean velocity equations (including seepage in soils)
- Potential flow relationships
- Allows lecturers to represent flow in other branches of engineering, such as aerodynamics or electricity and heat flow

RECOMMENDED ANCILLARIES:

- Header Tank (H9a) – A wall-mounted tank with a float valve, overflow and a flow-control valve and pipework

ALTERNATIVE PRODUCTS:

- Flow Visualisation (FC15) 92
- Flow Through an Orifice (H4) 104

PIPE SURGE AND WATER HAMMER

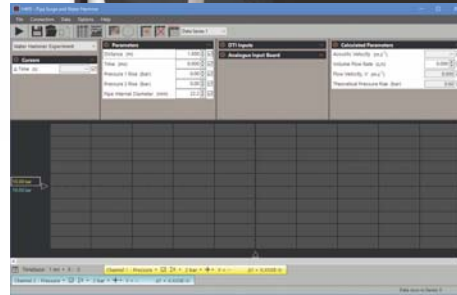
VDAS® H405

A self-contained unit for teaching the transient effects of pipe surge and water hammer caused by sudden flow rate changes in pipes.



SHOWN WITH A
HYDRAULIC BENCH
AND VDAS®

- Multiple pipes and valves provide two different experiments in one product
- Two pressure sensors in the water hammer test pipe help calculate velocity of sound in pipes
- Transparent surge tower so students can see what is happening
- Works with TecQuipment's VDAS® for real-time display of the pressure surges and acoustic waves



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

The apparatus has two separate test pipes: one for water hammer investigations and one for surge investigations. A header tank supplies both test pipes, and includes an internal overflow weir to keep a constant head.

LEARNING OUTCOMES:

Investigations into the transient effects of pipe surge and water hammer caused by changing flow rates in pipes including:

- Demonstration and analysis of pipe surge
- Demonstration and analysis of water hammer
- Determination of frictional head loss between reservoir and surge tower
- Determination of pressure profiles
- Determination of velocity of sound in the test pipe

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – bench-mounted version (VDAS-B) 299

NOTE: This equipment needs the latest VDAS® and will not work with early versions of VDAS®. Contact TecQuipment or your local agent if unsure.

ALTERNATIVE PRODUCTS:

- Water Hammer Apparatus (TE86) 111

WATER HAMMER APPARATUS

TE86

Demonstrates water hammer and cavitation and the propagation of shock waves at sonic velocity in water.

- Illustrates the propagation of shock waves at sonic velocity in water
- Demonstrates how to calibrate an electronic pressure transducer
- Includes an electric valve to stop flow instantly
- Contains over 60 m of pipe in one compact unit to save space
- Includes mechanical and electronic pressure measurement
- Includes connectors for extra (optional) equipment for transient measurements



LEARNING OUTCOMES:

- Water hammer
- Propagation of shock waves in water
- Velocity of sound in a water filled pipe
- Transducer calibration

The apparatus is made up of a coil of copper pipe 60 m long. The inlet connects to a water supply and the discharge end has a solenoid valve.

ESSENTIAL ANCILLARIES:

- Dual Beam Storage Oscilloscope (H405a) 303

ALTERNATIVE PRODUCTS:

- Pipe Surge and Water Hammer (H405) 110

UPGRADE YOUR KIT

Upgrade mercury-filled older generation TecQuipment **LOSSES IN PIPING SYSTEMS** (H16) and **FRICTION LOSS IN A PIPE** (H7) with upgrade kits (H16x and H7x) – eliminate the use of mercury.

FEATURES:

- Easy to use with quick-connect couplings
- Electronic pressure measuring instrument specification:
 - Range 0-2 bar
 - Accuracy 0.15% rdg + 0.1 fs + digit

BENEFITS:

- Health and safety – eliminates the use of mercury, which is widely prohibited from use in the teaching laboratory
- Improved accuracy
- Purchase from maintenance budget



OPEN CHANNEL FLOW EQUIPMENT AT THE UNIVERSITY OF DERBY

Reliability, expansive functionality, customer service and competitive price were the main reasons why the University of Derby chose to invest in a sizeable piece of fluid mechanics equipment from TecQuipment.

EXPANDING FACILITIES

With the completion of the University of Derby's STEM (science, technology, engineering and maths) centre, the academic team were very keen on expanding their fluid mechanics and hydraulics capabilities. They turned to the engineering education equipment market to source a large flow channel that would be accurate, provide excellent visualisation of flow channel characteristics, while also being flexible enough to perform a wide range of experiments for undergraduate and postgraduate study and research. The limited space available within the newly built STEM centre meant that the challenge was on to deliver a ten-metre flow channel that would fit in between pillars with a relatively low ceiling, while still enabling students to move around the apparatus.



REDUCING EXPERIMENT TIME WHILE INCREASING DEPTH OF STUDY

TecQuipment offers a range of flume/flow channel lengths and widths to suit the space available and learning outcomes required: from the narrower channels of 50 mm width and 2.5 metres long, through to the wider 300 mm width channels available in 2.5 metre steps between five metres and 15 metres.

It was the wider 300 mm flume/flow channel in ten metres (FC300-10) that the University of Derby selected for their fluids laboratory. Not only was this equipment larger than their existing flow channel, and therefore made it easier to see the specific phenomena such as hydraulic jump, it also had much more advanced measurement functionality. That functionality, coupled with TecQuipment's Versatile Data Acquisition System (VDAS®) connected to a 32-way pressure display unit, allowed for more in-depth study and research. Mathew Whomsley, Technical Instructor at the University of Derby, commented: "The addition of VDAS® also meant that the experiments could be performed much more quickly, taking a fraction of the time it would have done previously."

THE SPACE CHALLENGE

The limited physical size of the room with its various pillars and low ceiling was a point of concern for the team at the University of Derby.

"One of the biggest constraints in our original specification was the space constraints in the room. TecQuipment was

exemplary when dealing with this, by conducting a site survey of the space and having discussions about key dimensions within the room, such as columns. TecQuipment subsequently provided the university with floor plans and 3D views of the flume within the room, to give us peace of mind that the equipment will be useable within our space requirements," explained Whomsley.

RETURNING TIME AND TIME AGAIN

The University of Derby already had a range of TecQuipment products within their engineering department and were confident in the quality of the products and ongoing customer support available, which contributed to the decision to select TecQuipment over other equipment providers.

Summarising, Whomsley explained: "Overall, our excellent history with TecQuipment is the reason we continue to purchase equipment through them. Their team is always friendly, helpful, and they offer good equipment at a reasonable price."

THE UNIVERSITY OF DERBY CLIMBS THE LEAGUE TABLES

The University of Derby has recently gained a significant increase in credibility, particularly among universities offering mechanical engineering undergraduate and postgraduate degrees within the UK, ranking 18th in the 2019 Guardian University League Tables. In another league table offered by the Times, they are ranked the 13th best university in the UK for teaching quality.

In addition, the team at the University of Derby has a mission-focused outlook that aims to continue to attract well-motivated undergraduate and postgraduate civil engineering students, and prepare them for work within the growing water sector, offering a full range of courses in civil engineering, i.e. MEng, MSc, BEng and BSc.

A PROFESSIONAL AND KNOWLEDGEABLE TEAM

“The experience throughout the whole process of buying the flume from TecQuipment has been very good. From when the order of the flume went in, we were given regular updates on the progress of the flume, alongside reliable delivery schedules. During the installation and induction, the team were

professional and knowledgeable on both the practical and theoretical aspects of the flume,” explained Whomsley.

“TecQuipment are well established as a provider of innovative and well developed science and technology equipment to the education sector, and having previous experience of the services offered and their reliability, then as a local supplier, TecQuipment fits our needs. Installation of the equipment went smoothly, including thoughtful and dedicated induction for both technicians and academics; the example experiments including example data are particularly useful. To date, the FC300 flume/flow channel has been very effective in contributing to our objectives.”



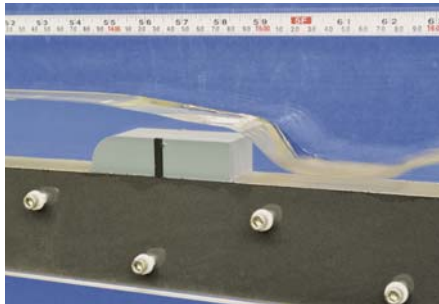
2.5-METRE FLOW CHANNEL

FC50-2.5

Demonstrates flow around weirs and other objects in an open channel. Supplied with all the models and instrumentation required for a complete package in flow channel investigations.



SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) – AVAILABLE SEPARATELY



FLOW OVER BROAD CRESTED WEIR

- Inclinable acrylic channel providing maximum flow visualisation
- Inlet includes baffle section to provide steady flow conditions
- Works with TecEquipment’s Digital Hydraulic Bench (H1F) for easy installation
- Includes:
 - Broad-crested weir
 - Sluice gate (undershot weir)
 - Venturi flume
 - Sharp-crested weir
 - Cylindrical gate
 - Crump weir
 - Instrument level gauge
 - Pitot tube

The apparatus consists of a floor-standing 2.5-metre, 53 mm wide flow channel, together with various gates, weirs and blocks, enabling the phenomena of flow channels to be easily demonstrated and studied. The FC50 is TecEquipment’s most compact flume, providing simple installation and flexible storage in the laboratory.

LEARNING OUTCOMES:

- Study of sluice and drum gates including investigation into hydraulic jump, specific energy and the determination of discharge coefficient
- Study of submerged narrow-crested and crump weirs revealing the relationship between head over a weir and discharge
- Study of a broad-crested weir (by combining the square and radius jump blocks) and the effects of changing the profile of the weir
- Study of uniform flow in an inclined channel with investigations into the Chézy factor and coefficient
- Study of a Venturi flume to indicate the discharge and surface profile, thus the derivation of the discharge coefficient

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Sediment Transport Channels (FC80) 115
- Flow Channels (FC300) 117

FLOW AND SEDIMENT TRANSPORT CHANNELS

FC80 (2.5 AND 5)

Open channel flumes that provide students with the ability to study the varying effects of sediment transport, bedform dynamics and fluid flow in an open channel.



2.5-METRE SEDIMENT TRANSPORT CHANNEL

- Includes four models with the flume for comprehensive experimentation options
- Digital flowmeter for quick and accurate measurements
- Transparent sides for clear visibility, ideal for group demonstrations
- Stainless steel beam and toughened glass channel walls, provides long-lasting use with sedimentation
- Built-in recirculating water supply for convenient laboratory use
- Includes two bags of graded sand for sediment experiments, e.g. bed form development or scour



SUBCRITICAL AND CRITICAL FLOW PAST A PIER

ALTERNATIVE PRODUCTS:

- | | |
|-------------------------------------|-----|
| • 2.5-Metre Flow Channel (FC50-2.5) | 114 |
| • Flow Channels (FC300) | 117 |

The FC80 Flow and Sediment Transport Channel working sections are 80 mm in width and 247 mm deep. They are available in 2.5 metre and 5 metre lengths. Each flume has a built-in recirculating water supply connected to a digital flowmeter for accurate measurements during experimentation.

The models included with each flume are:

- Broad-crested weir
- Sharp-crested weir
- Venturi flume
- Sluice gate



BROAD-CRESTED WEIR

LEARNING OUTCOMES:

- Investigations in fixed and smooth bedform
- Mechanics of sediment transport
- Local (bridge) scour experiments, to understand scour holes and effects on the integrity of a structure
- Sluice gate for investigations into hydraulic jump, specific energy and the determination of discharge coefficient
- Submerged sharp-crested weir reveals the relationship between head over a weir and discharge
- A broad-crested weir and the effects of changing the profile of the weir
- Uniform flow in an inclined channel with investigations into the Chezy factor and coefficient
- A Venturi flume to indicate the discharge and surface profile, thus the derivation of the discharge coefficient

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5-METRE SEDIMENT TRANSPORT CHANNEL



FLOW UNDER A SLUICE GATE

OPEN CHANNEL FLOW

FLUID MECHANICS

RECOMMENDED ANCILLARIES:

OPTIONAL MODELS:

DRUM GATE FC80A	RADIAL SECTOR GATE FC80B	GRUMP WEIR FC80D	DAM SPILLWAY FC80E
STREAMLINED HUMPH FC80G	PARSHALL FLUME - REQUIRES VENTURI SIDES (INCL) FC80H	BRIDGE PIERS - CYLINDER, ROUND, SQUARE, SHARP NOSE FC80J	ROUGHENED BED FC80K
WAVE GENERATOR AND BEACH FC80N	SIPHON SPILLWAY FC80L	CULVERT MODEL FC80P	FLOW SPLITTER FC80V

FLOW CHANNELS

VDAS® FC300

Large open channel flumes that provide the opportunity for advanced research and student study on a wide range of fluid flow topics. Select a length (5 to 15 m) to suit needs and the space available.



SCREENSHOT OF THE VDAS® SOFTWARE

- Digital data acquisition for quick and accurate measurements
- Transparent sides for clear visibility – ideal for group demonstrations
- Stainless-steel channel base plate and toughened-glass channel walls provide long-lasting use
- Built-in re-circulating water supply for convenient laboratory use
- Bed plate pressure tappings at 0.25-metre intervals, providing detailed analysis potential

The FC300 series flume working sections are 300 mm in width and 450 mm deep. They come in 2.5-metre sections and are available in 5-metre, 7.5-metre, 10-metre, 12.5-metre and 15-metre lengths.

Included with the flow channel:

- Sluice gate
- Level gauges
- Pitot tube
- Sharp-crested weir
- Powered end gate



HOOK DEPTH GAUGE

LEARNING OUTCOMES:

- Sluice gate for investigations into hydraulic jump, specific energy and the determination of discharge coefficient
- Submerged sharp-crested weir reveals the relationship between head over a weir and discharge
- A broad-crested weir and the effects of changing the profile of the weir (optional ancillary)
- Uniform flow in an inclined channel with investigations into the Chezy factor and coefficient
- A Venturi flume to indicate the discharge and surface profile, thus the derivation of the discharge coefficient
- Further experimentation with additional optional models
- With the optional Sediment Loop (FC300sl) sediment transport, scouring, ripple and dune formation and similar studies can be performed



FC300 CONTROL BOX AND INSTRUMENT FRAME (SHOWN WITH VDAS® - INCLUDED)


ALTERNATIVE PRODUCTS:

- | | |
|--------------------------------------|-----|
| • 2.5-Metre Flow Channel (FC50-2.5) | 114 |
| • Sediment Transport Channels (FC80) | 115 |

CONTINUED ON NEXT PAGE

RECOMMENDED ANCILLARIES:

INSTRUMENTATION:

			
INSTRUMENT CARRIER FC300IC	WATER VELOCITY METER FC300X	MULTI-TUBE MANOMETER FC300W	
			
	32-WAY PRESSURE DISPLAY FCAI	DIGITAL INSTRUMENT CARRIER FC300IC2	

MODELS:

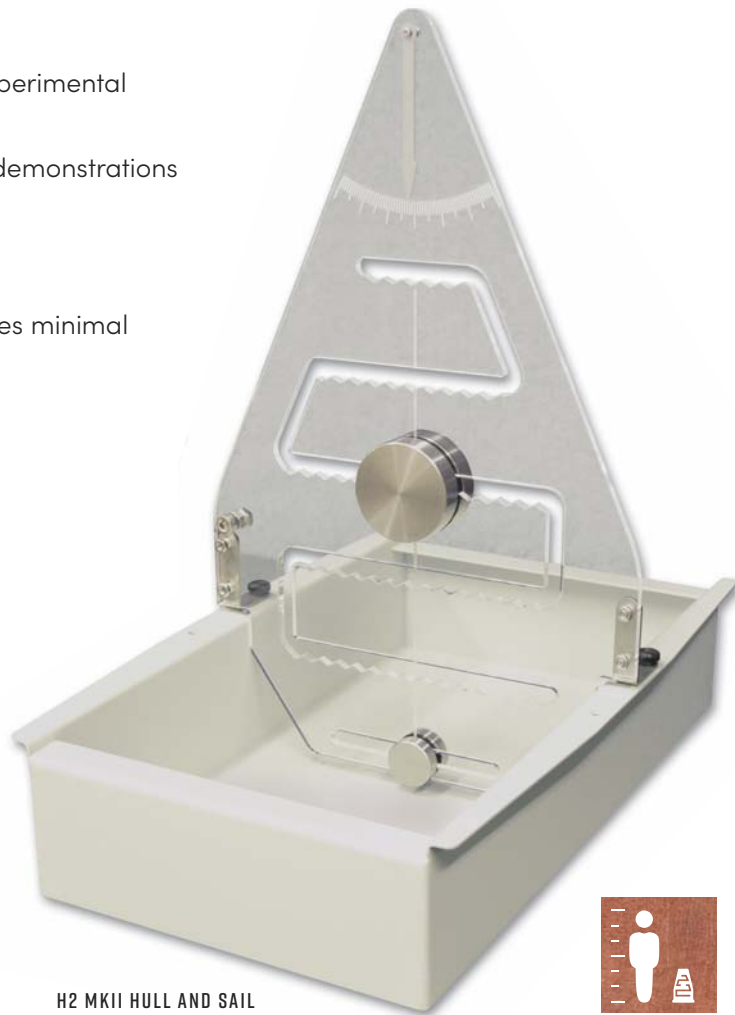
			
RADIAL GATE FC300B	SLUICE GATE (UNDERSHOT WEIR) FC300C	GRUMP WEIR FC300D	DAM SPILLWAY FC300E
			
OGEE WEIR WITH TAPPINGS FC300E2	ENERGY DISSIPATION FC300E3	VENTURI FLUME FC300F	PARSHALL FLUME FC300H
			
BRIDGE PIERS: CYLINDER, ROUND AND SHARP NOSE, SQUARE FC300J	ROUGHENED BED FC300K SAND FC300K2, TURF FC300K3	SIPHON SPILLWAY FC300L	SELF REGULATING SIPHON FC300L2
			
LIFT AND DRAG FC300LD	VIBRATING PILES FC300M	WAVE GENERATOR AND BEACH FC300N	CULVERT MODEL FC300P
			
RECTANGULAR AND V-NOTCH WEIRS FC300Q	BROAD CRESTED WEIRS: SHARP AND STREAMLINED FC300R	TRAPEZOIDAL FLUME FC300Z	SEDIMENT LOOP FC300SL

METACENTRIC HEIGHT AND STABILITY

H2 MKII

A bench-mounted apparatus to determine the stability of a pontoon with its centre of gravity, metacentric height and metacentre at various heights.

- Full and accurate experimental analysis
- Ideal for classroom demonstrations
- Bench-mounted
- No services required
- Compact and requires minimal storage space



H2 MKII HULL AND SAIL

LEARNING OUTCOMES:

Determination of the metacentric height, and thus the metacentre, of a floating pontoon. This is by graphic analysis of the angles of tilt of the pontoon with various centres of gravity.



OPTIONAL VEE (HARD) CHINE AND HALF ROUND (ROUND BILGE) HULLS (H2A MKII)

The experiment consists of a rectangular pontoon floating in water. Plastic materials and corrosion-resistant finishes throughout the equipment give the fullest possible protection against corrosion.

RECOMMENDED ANCILLARIES:

- Vee (Hard) Chine and Half Round (Round Bilge) Hulls (H2a MkII)

ALTERNATIVE PRODUCTS:

- Hydrostatics and Properties of Fluids (H314) 121

CENTRE OF PRESSURE

H11

A pivoted, clear-plastic assembly which students use to find the centre of pressure of a totally or partially submerged plane surface. Compact, self-contained and excellent for classroom demonstrations.

- Compact and self-contained – just needs clean water
- Determines theoretical centre of pressure and compares actual and theoretical hydrostatic thrust
- Simple but accurate balance to measure moment due to hydrostatic thrust
- Tests a vertical and inclined plane surface



LEARNING OUTCOMES:

- Studying the relationship between hydrostatic force and head of water for a fully and partially submerged vertical and inclined plane
- Comparison of actual and theoretical hydrostatic force on a fully or partially submerged plane for any given head of water
- Theoretical calculation of the position of centre of pressure on a fully or partially submerged plane

The equipment consists of a vertical panel that holds a clear plastic quadrant, to which students add water. The plane works in either a vertical or inclined (angled) position. Students then compare their measurements with theoretical analysis.

ALTERNATIVE PRODUCTS:

- Hydrostatics and Properties of Fluids (H314)

121

METICULOUSLY PACKED

TecEquipment's dedicated packing department uses specialist equipment, custom-made transit crates and the most reliable global carriers to ensure products are delivered in perfect condition.



HYDROSTATICS AND PROPERTIES OF FLUIDS

H314

Self-contained, mobile unit for many experiments in fluid mechanics, from Archimedes' principle to the stability of a floating body.



- Wide range of experiments
- Determination of fluid properties including density, specific gravity, surface tension and viscosity
- Demonstration of hydrostatic principles, including Pascal's law, Archimedes' principle and determination of pressure at a point in a fluid
- Experiments cover study of buoyancy, flotation and stability of floating bodies, forces on a plane surface, centre of pressure, operation and calibration of a Bourdon pressure gauge and liquid column manometers

LEARNING OUTCOMES:

- Determination of fluid density and specific gravity
- Principles and use of a hydrometer
- Capillarity in tubes and between plates
- Measurement of viscosity by falling sphere method
- Demonstration of Pascal's law
- Measurement of fluid levels by Vernier hook gauge
- Fluid flow head relationship
- Verification of Archimedes' principle and demonstration of principles of flotation
- Stability of a floating body and determination of metacentric height
- Measurement of force and centre of pressure on a plane surface
- Operation and calibration of a Bourdon pressure gauge
- U-tube manometers with fluids of different density

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HYDROSTATICS AND PROPERTIES OF FLUIDS (H314) CONTINUED FROM PREVIOUS PAGE

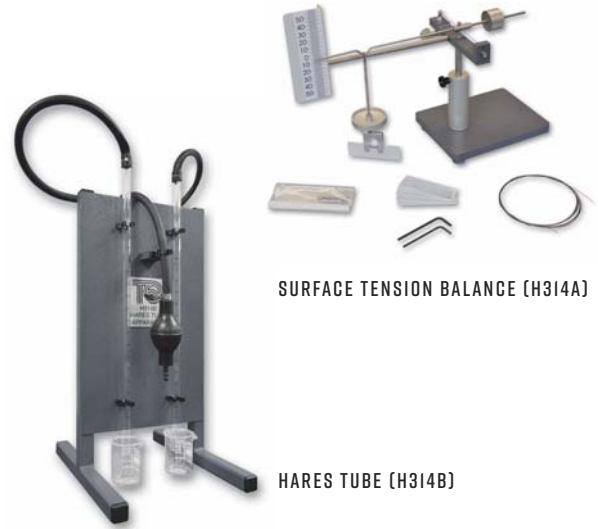
The apparatus consists of a self-contained bench, complete with all necessary equipment for a wide range of demonstrations and experiments in hydrostatics and properties of fluids. Much of the equipment is rigidly mounted on the bench, the remainder being free-standing items suitable for use on the bench top.

RECOMMENDED ANCILLARIES:

- Surface Tension Balance (H314a)
- Hares Tube (H314b)

ALTERNATIVE PRODUCTS:

- Metacentric Height and Stability (H2 Mk II) 119
- Calibration of a Bourdon Pressure Gauge (H3a) 92
- Centre of Pressure (H11) 120
- Pressure Measurement Bench (H30) 96



SURFACE TENSION BALANCE (H314A)

HARES TUBE (H314B)

VISCOSITY AND PARTICLE DRAG

H410

Demonstrates the drag coefficient of different sized particles (spheres) and the viscosity of liquids.

- Chemically inert, high-quality clear-glass tube for use with water and other suitable fluids
- Safe, low-voltage backlighting so students can see the falling test spheres through dark fluids (low translucence)
- Includes test spheres of different sizes and densities to help match a range of test fluids
- Includes stopwatch and timing marks for accurate results



LEARNING OUTCOMES:

- Determination of the viscosity of different fluids
- Determination of the drag coefficient of various spheres

The self-standing Viscosity and Particle Drag apparatus is a simple falling-sphere viscometer. A back plate holds a glass tube filled with the test fluid.

ALTERNATIVE PRODUCTS:

- Osborne-Reynolds Apparatus (H215) 103

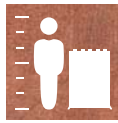


LIQUID SEDIMENTATION APPARATUS

H311

A self-contained, bench-mounting apparatus for studies into the settling characteristics of suspended solids and the display of wall effects.

- Finds settling characteristics and particle sizes of suspended solids
- Five identical sedimentation columns for comparison of different sediments
- Translucent rear panel with back lighting for better visibility
- Includes stopwatch, measuring beakers and specific gravity bottle



LEARNING OUTCOMES:

- Comparison of settling characteristics of different sediments
- Determination of the effect of concentration on settling characteristics (hindered settlement)
- Determination of velocity distribution curves
- Comparison of flocculent and particle suspensions
- Determination of particle size distribution (grading curve) by liquid sedimentation

The bench-mounted apparatus consists of five long, transparent sedimentation columns mounted on a rigid frame.

ALTERNATIVE PRODUCTS:

- Sediment Transport Channel (FC80) 115



DOWNLOAD POSTERS, SOFTWARE AND CATALOGUES

TecQuipment offers a wide range of digital content such as posters, brochures, catalogues, charts and software on the website.

TECQUIPMENT.COM/DOWNLOADS



PERMEABILITY, FLOW NETS AND DARCY'S LAW

H312

Demonstrates flow through permeable media with common structures, such as dams or walls.



- Dye-injector system to help demonstrate flow lines
- Clear plate glass resists abrasion and allows students to see flow patterns
- Includes pressure tapings and piezometer tubes to measure head distribution
- Plates supplied to simulate models of walls, sheet piling and dams
- Self-contained, floor-standing unit – only needs water supply and drain



The apparatus is a transparent-sided tank, mounted on a steel-framed bench with worktop. The tank is clear so students can see the flow patterns. The sides are plate glass to resist abrasion from the permeable medium. The rear of the tank contains pressure tapings with filters that stop any unwanted particles. The tapings connect to a bank of piezometer tubes at the side of the apparatus, which allows measurement of the head distribution along the tank.

RECOMMENDED ANCILLARIES:

- Permeable Medium (H312a) – Washed sand, graded 0.5 mm to 1.5 mm

LEARNING OUTCOMES:

- Determination of seepage beneath a structure
- Construction of flow nets and determination of coefficient of permeability
- Flow under a sheet pile and determination of critical seepage force at which 'piping' occurs
- Seepage flow under an impermeable dam
- Flow through an earth dam with and without a toe drain
- Drawdown in horizontal flow (simulation of groundwater flow into a river or well)
- Determination of uplift pressures on structures such as building foundations
- General studies of seepage and drainage
- Flow through a porous medium (Darcy's law)

HYDROLOGY AND RAINFALL APPARATUS

H313

For studying hydrology principles, including rainfall, through flow and movement of water over land and rivers.



- Permeable catchment area fed with 'rain' from overhead spray nozzles and/or by groundwater flow from ends of tank
- Spray nozzles to supply half or all of catchment area
- Can measure 'drawdown' due to single or two interacting wells
- Self-contained – requires only an electrical supply

The apparatus is a sturdy metal frame which holds a large rectangular stainless-steel tank (catchment area) and a reservoir tank. Students can fill the catchment area with a granular medium (not included) to form a permeable catchment area. A jacking mechanism allows adjustment of the angle of the catchment area. Above the catchment area is a frame that holds spray nozzles which simulate rainfall on the catchment. A valve selects all or half the nozzles. Students can use this facility to vary the lag time on a hydrograph, or to simulate a moving storm. At each end of the catchment area are end compartments, separated from the catchment by weir plates with porous 'port holes'. The port holes can be opened to drain water from the catchment area, or to supply water to it from the end



LEARNING OUTCOMES:

- Investigation of rainfall/run-off relationships for dry, saturated and impermeable catchments of various slopes (surface run-off only)
- Effect of interflow on outflow hydrograph surface run-off (plus groundwater flow)
- Simulation of multiple and moving storms
- Measurement of cone of depression for a single well, and comparison with theory interaction of cones of depression for two adjacent wells
- De-watering of excavation sites by use of wells
- Flow from a well in a confined aquifer
- Demonstration of watersheds for a simulated island with rainfall and well flows
- Sediment transport and meanders in simulated rivers
- Studies of scour around simulated bridge piers

compartments. In the middle of the catchment area are two 'wells' for experiments with water wells. A row of 20 tapings along the centre line of the catchment area allows the measuring of the water table profile. Each tapping has special slotted ends to stop the permeable media entering its pipe. The tapings connect to a bank of piezometer tubes at the front of the catchment area.

RECOMMENDED ANCILLARIES:

- Permeable Medium (H313a) – Washed sand, graded 0.5 mm to 1.5 mm

FRANCIS TURBINE

H18

Demonstrates how a Francis turbine works and tests its performance.

- Mounts onto TecEquipment's Digital Hydraulic Bench (H1F) for flow measurement and easy installation
- Includes band brake to measure turbine torque
- Fully adjustable guide vanes with position indicator
- Includes pressure gauge to measure inlet pressure



LEARNING OUTCOMES:

- Efficiency of a Francis turbine
- Performance of a Francis turbine at different flow rates
- The effect of different guide vane settings on turbine performance

The turbine has a sturdy base which sits on the top of the hydraulic bench (H1F). The turbine connects to the pumped supply of the hydraulic bench. The bench measures the flow rate. A mechanical gauge measures the inlet pressure to the turbine. Adjustable guide vanes in the turbine alter the flow rate and direction of flow to the impeller (runner) of the turbine. The end of the turbine outlet tube (draft) sits in the recess in the top of the hydraulic bench.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ESSENTIAL ANCILLARIES:

- Optical Tachometer (OT1) 303

RECOMMENDED ANCILLARIES:

- Stroboscope (ST1) 303

ALTERNATIVE PRODUCTS:

- Francis Turbine (MFP101d) 138
- Pelton Turbine (H19) 127

PELTON TURBINE

H19

A compact unit for demonstrations and performance tests on a Pelton turbine.

- Works with TecQuipment's Digital Hydraulic Bench for easy installation
- Includes dynamometer to load the turbine and help find the power absorbed (needs an optional tachometer to find speed)
- Includes inlet pressure gauge
- Screw-controlled spear valve for precise inlet flow control

LEARNING OUTCOMES:

- Performance charts of power, speed, torque and efficiency
- The effect of spear valve position

The product consists of a Pelton wheel mounted in a corrosion-resistant enclosure. A transparent front panel allows students to see the turbine working. An optional stroboscope (ST1, available separately) can 'freeze' the image of the turbine to help students better understand how it works. An adjustable spear valve directs a jet of water through a nozzle to the buckets of the Pelton wheel to make it turn. Manual adjustment of the spear valve controls the water jet from the nozzle.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ESSENTIAL ANCILLARIES:

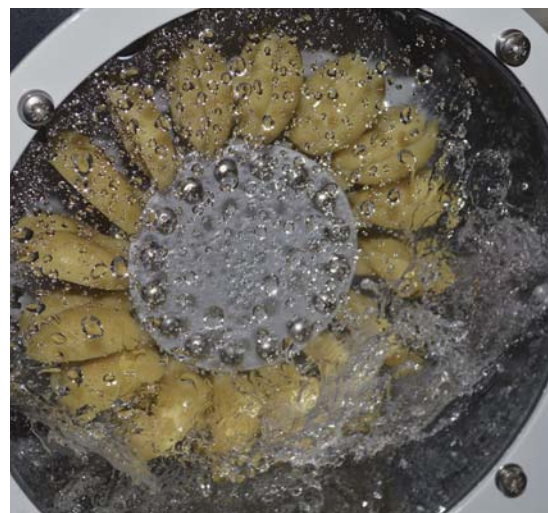
- Optical Tachometer (OT1) 303

RECOMMENDED ANCILLARIES:

- Stroboscope (ST1) 303

ALTERNATIVE PRODUCTS:

- Impact of a Jet (H8) 105
- Francis Turbine (H18) 126
- Pelton Wheel (Turbine) (MFP101b) 137



HYDRAULIC RAM PUMP

H3I

Demonstrates the use of water hammer to create a pumping action.

- Works with TecEquipment's Digital Hydraulic Bench for easy installation
- Includes air vessel to reduce hydraulic shock
- Ideal for demonstrations to small groups of students
- Includes header tank and all necessary pipework



SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY

LEARNING OUTCOMES:

- Demonstration of the water hammer effect to produce a pumping action

The ram pump is not a normal mechanically-operated pump. A column of water in the supply (drive) pipe from a header tank, moving at low velocity, is similar to a 'plunger'. The energy in the plunger forces water from the supply into a delivery pipe. This exchanges the momentum of a large amount of water into energy that pumps a smaller amount of water up a hill or gradient.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F)

91

TECQUIPMENT BLOG

Read the TecEquipment blog for informative posts from topics focused on engineering education, through to guest posts from academics sharing view points and relevant teaching projects and perspectives.

TECQUIPMENT.COM/KNOWLEDGE



CENTRIFUGAL PUMP TEST SET

VDAS® H47

For a comprehensive range of investigations into the performance and characteristics of a centrifugal pump. Demonstrates cavitation and the use of a Venturi tube.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

TEST SET WITH ANALOGUE PRESSURE MEASUREMENT, DIGITAL PRESSURE MEASUREMENT AND VERSATILE DATA ACQUISITION UNIT

- Pump has a transparent 'window' to allow students to see clearly its impeller, the water flow and cavitation
- Demonstrates how to use a Venturi meter and differential pressure measurement to find flow rate
- Optional stroboscope allows students to see clearly the effects of cavitation around the pump impeller
- Optional easy-to-read analogue instrumentation

LEARNING OUTCOMES:

Comprehensive demonstrations and investigations into a centrifugal pump including:

- Centrifugal pump performance and characteristics, typically head versus flow and efficiency versus flow
- Non-dimensional performance characteristics
- Flow measurement using a Venturi tube
- Demonstration of cavitation

CONTINUED ON NEXT PAGE

A motor mounted in bearings drives the pump. The pump draws water from the integral reservoir. The water travels up through a valve and filter, through an inlet valve to the pump body, then out through a delivery valve. It then passes through a Venturi meter and returns to the reservoir for re-use. This self-contained water supply keeps water consumption to a minimum. The pump has a transparent 'window' so students can see the impeller turning and how the water vapour bubbles form in the pump at cavitation. The optional stroboscope makes the effect easier to see.



CAVITATION DEMONSTRATION

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 299
- Stroboscope (ST1) 303
- Analogue Pressure Display (API)
- Digital Pressure Display (DPI)

ALTERNATIVE PRODUCTS:

- Series and Parallel Pumps (H52) 131
- Two-Stage (Series and Parallel) Pumps (H83) 132
- Centrifugal Pump Module (MFP101) 135



DIGITAL PRESSURE DISPLAY (DPI)

SOCIAL MEDIA

Find out all the latest up-to-the-minute news, promotions, stories from users and videos etc.

Plus, embrace the opportunity to interact with other academics, students and get fresh ideas.



SERIES AND PARALLEL PUMPS **NEW**

H52

Bench-top test set that allows students to investigate the operation and performance of a single centrifugal pump and two centrifugal pumps in both series and parallel.



- Self-contained, compact, bench-top, easy-to-use test set for a range of experiments and demonstrations
- Easily configurable system to enable pumps to be tested individually, in series and in parallel, with a manually adjustable water flow rate
- Long-life, robust valves with large handles allow students to change the water circuit in seconds, ready for the next experiment
- Includes pressure gauges to measure intake and delivery pressures
- Discharge flow measurement

LEARNING OUTCOMES:

Comprehensive demonstration and investigation into a centrifugal pump including:

- Centrifugal pump performance and characteristics, typically: head versus flow and efficiency versus flow
- Operation of centrifugal pumps in series
- Operation of centrifugal pumps in parallel

The apparatus comprises two identical centrifugal pumps, together with two bearing-mounted motors driving each pump independently. The pumps draw water from the clear acrylic reservoir. The water travels through a series of valves to be delivered to a flow measurement device. The water then returns to the reservoir for re-use, keeping water use to a minimum.

ALTERNATIVE PRODUCTS:

- | | |
|---|-----|
| • Centrifugal Pump Test Set (H47) | 129 |
| • Two-Stage (Series and Parallel) Pumps (H83) | 132 |
| • Centrifugal Pump Module (MFP101) | 135 |

TWO-STAGE (SERIES AND PARALLEL) PUMPS

VDAS[®] H83

For a comprehensive range of investigations into the operation and characteristics of a single centrifugal pump, and two centrifugal pumps in both series and parallel.



TEST SET SHOWN
WITH ALL
INSTRUMENTATION
OPTIONS AND
VERSATILE DATA
ACQUISITION
SYSTEM



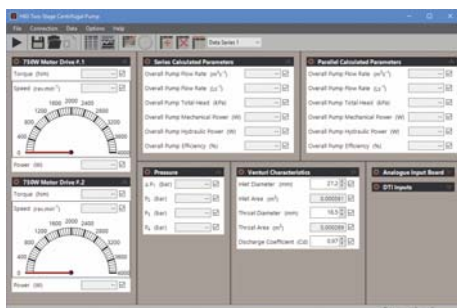
- Pumps have a transparent 'window' to clearly see the impellers, water flow and cavitation
- Pumps can be tested individually, in series and in parallel, with independent speed control
- Demonstrates how to use a Venturi meter and differential pressure measurement to find flow rate
- Optional stroboscope allows students to see clearly the effects of cavitation around a pump impeller
- Works with TecEquipment's Versatile Data Acquisition System (VDAS[®]) and software

LEARNING OUTCOMES:

Comprehensive demonstrations and investigations into a centrifugal pump including:

- Centrifugal pump performance and characteristics, typically head versus flow and efficiency versus flow
- Non-dimensional performance characteristics
- Flow measurement using a Venturi tube
- Demonstration of cavitation
- Operation of centrifugal pumps in series
- Operation of centrifugal pumps in parallel

Two bearing-mounted motors drive each pump independently. The pumps draw water from the integral reservoir. The water travels through strainers and a series of valves to be delivered to a Venturi meter. The water then returns to the reservoir for re-use, keeping water use to a minimum. The pumps each have a transparent 'window' so students can see the impeller turning and how the water vapour bubbles form in the pump at cavitation. The optional stroboscope makes the effect easier to see.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 299
- Stroboscope (ST1) 303
- Analogue Pressure Display (AP2)
- Digital Pressure Display (DP1)

ALTERNATIVE PRODUCTS:

- Centrifugal Pump Test Set (H47) 129
- Series and Parallel Pumps (H52) 131
- Centrifugal Pump Module (MFP101) 135

PLAY NOW - TECQUIPMENT YOUTUBE CHANNEL

Visit and subscribe to the TecQuipment YouTube channel for all the latest products showcase, installation and user videos. [YOUTUBE.COM/C/TECQUIPMENT](https://www.youtube.com/c/tecquipment)



OPTIONAL SMOKE GENERATOR

SUBSONIC WIND TUNNEL (AF1600)



FREE VIBRATIONS (TM160 SERIES)



BENCH-TOP TENSILE TESTING MACHINE (SM1002)

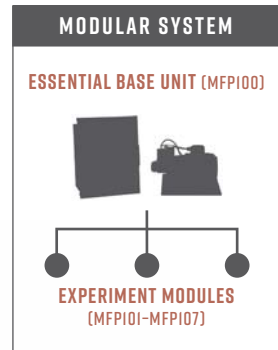
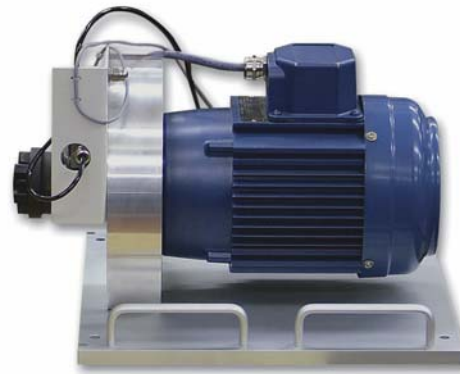


2.5 METRE FLOW CHANNEL (FC50)

UNIVERSAL DYNAMOMETER

MFP100

Provides motive power with speed, torque and power measurements for TecQuipment's Modular Fluid Power range.



FEATURES:

Provides motive power to seven different experiment modules

Multiple electrical outlets for instruments

Quick and easy transfer from one experiment module to another

Direct drive

BENEFITS:

➔ Modular design saves space and reduces costs

➔ No need for extra power sockets and increases safety

➔ Maximises experiment time

➔ No belts or pulleys to adjust

A precision-machined base plate holds the motor and its sensors. The base plate has location points to give accurate and repeatable alignment onto each Fluid Power module. The coupling between the Universal Dynamometer and all Fluid Power machines is a jaw-type coupling with a rubber element. The Universal Dynamometer directly drives the Fluid Power machines. This means that the user has no need to fit or adjust the tension of belts and pulleys.

AVAILABLE EXPERIMENT MODULES:

• Centrifugal Pump Module (MFP101)	135
• Axial Flow Pump Module (MFP102)	139
• Positive Displacement Pump Module (MFP103)	140
• Reciprocating Compressor Module (MFP104)	143
• Centrifugal Compressor Module (MFP105)	144
• Centrifugal Fan Module (MFP106)	145
• Axial Fan Module (MFP107)	147

CENTRIFUGAL PUMP MODULE

VDAS[®] MFPI01

Allows students to study and perform tests on a centrifugal pump and optional turbines, to understand how they work and calculate performance.

SHOWN FITTED WITH
THE UNIVERSAL
DYNAMOMETER
(MFPI00), TURBINE
DYNAMOMETER AND
A TURBINE



LEARNING OUTCOMES:

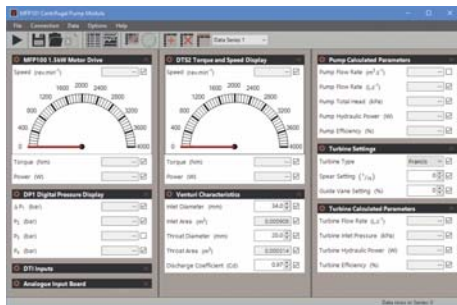
- Centrifugal pump performance and characteristics, typically head against flow and efficiency against flow
- Variation of pump performance with inlet pressure
- Variation of pump performance with speed
- Non-dimensional performance characteristics
- Flow measurement using a Venturi tube

- Centrifugal pump mounted in mobile frame with full instrumentation
- Part of TecQuipment's Modular Fluid Power range which connects with the Universal Dynamometer (MFP100) as a common motive power source, for a cost-effective solution
- Inlet and delivery valves for wide range of operating conditions
- Turbine dynamometer and turbines (available separately) – propeller, Francis and Pelton

CONTINUED ON NEXT PAGE

CENTRIFUGAL PUMP MODULE (MFP101) CONTINUED FROM PREVIOUS PAGE

The module includes a centrifugal pump, a Venturi flowmeter, valves, a reservoir and instrumentation – all mounted on a robust, mobile trolley for ease of use. The separate Universal Dynamometer (MFP100) measures and displays the speed and torque of the pump to calculate and display mechanical (shaft) power. Electronic pressure transducers measure the pump inlet and delivery pressures and the Venturi differential pressure (flow rate). Speed is fully variable up to the maximum allowable for the pump.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 134

AVAILABLE EXPERIMENT MODULES:

- Pelton Wheel (Turbine) (MFP101b) 137
- Propeller Turbine (MFP101c) 138
- Francis Turbine (MFP101d) 138

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 299
- Stroboscope (ST1) 303

ALTERNATIVE PRODUCTS:

- Centrifugal Pump Test Set (H47) 129
- Series and Parallel Pumps (H52) 131
- Two-Stage (Series and Parallel) Pumps (H83) 132

TURBINE DYNAMOMETER

VDAS® MFP101A

Dynamometer for the turbines of the Centrifugal Pump Module (MFP101).

- Dynamometer that fits on the Centrifugal Pump Module to test the optional turbines
- Electrically powered from outlets on the Universal Dynamometer motor drive
- Measures and displays torque, speed and shaft power
- Can connect to TecQuipment's Versatile Data Acquisition System (VDAS®)



ANCILLARY FOR:

- Pelton Wheel (MFP101b) 137
- Propeller Turbine (MFP101c) 138
- Francis Turbine (MFP101d) 138

NOTE: Only one Turbine Dynamometer is needed to test all three turbines.

PELTON WHEEL (TURBINE)

MFP101B

Impulse turbine for use with the Centrifugal Pump Module (MFP101).

- Optional turbine that fits on the Turbine Dynamometer (MFP101a) of the Centrifugal Pump Module (MFP101)
- Impulse turbine
- Variable spear jet



LEARNING OUTCOMES:

- Variation of turbine performance with inlet pressure and flow rate
- Variation of turbine performance with speed
- Non-dimensional performance characteristics

The Pelton wheel has a large wheel or 'runner' that has 'buckets' (turbine blades) that absorb the energy in the water. The buckets are in pairs to correctly balance the wheel and to work efficiently. The Pelton wheel has a variable spear jet at its inlet. This allows students to understand the effect of changing the velocity of the water that hits the buckets. A clear viewing window on the side of the turbine allows students to see how the turbine works.

ESSENTIAL BASE UNIT:

- Centrifugal Pump Module (MFP101) 135
- (with Universal Dynamometer MFP100) 134

ESSENTIAL ANCILLARIES:

- Turbine Dynamometer (MFP101a) 136

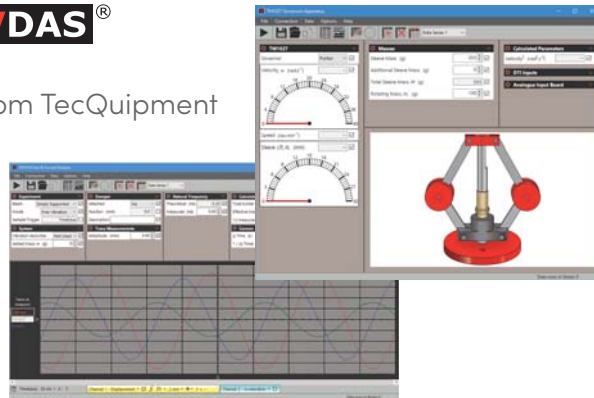
ALTERNATIVE PRODUCTS:

- Impact of a Jet (H8) 105
- Pelton Turbine (H19) 127

CAPTURE THE POWER OF **VDAS**[®]

...the Versatile Data Acquisition System from TecQuipment

Our Versatile Data Acquisition System (VDAS[®]) is a highly effective way of collecting and using data from experiments using TecQuipment's educational teaching equipment.



LOOK AT THE BENEFITS...

- VERSATILE** – can be used across a wide range of TecQuipment products
- DATA** – transforms raw data instantly which easily exports or creates sophisticated graphs and tables
- ACQUISITION** – USB connectivity, multiple-source real-time data capture
- SYSTEM** – an expandable modular approach providing easy-to-use digital plug-and-play technology

LABVIEW

All TecQuipment products compatible with VDAS[®] have the capability to interface with a LabVIEW environment.

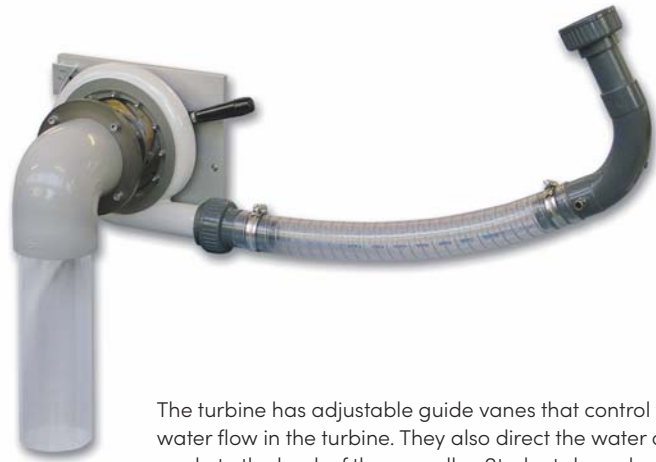
Visit TECQUIPMENT.COM for more information.

PROPELLER TURBINE

MFP101G

Propeller turbine for use with the Centrifugal Pump Module (MFP101).

- Optional turbine that fits on the Turbine Dynamometer (MFP101a) of the Centrifugal Pump Module (MFP101)
- Inward flow reaction turbine
- Four-blade propeller
- Fully adjustable guide vanes



The turbine has adjustable guide vanes that control the water flow in the turbine. They also direct the water at an angle to the back of the propeller. Students learn how the guide vane setting affects how the turbine works. The turbine has a clear viewing window around the guide vanes and a clear draft tube so that students can see the turbine working.

LEARNING OUTCOMES:

- Variation of turbine performance with inlet pressure and flow rate
- Variation of turbine performance with speed
- Non-dimensional performance characteristics

ESSENTIAL BASE UNIT:

- Centrifugal Pump Module (MFP101) 135
(with Universal Dynamometer MFP100) 134

ESSENTIAL ANCILLARIES:

- Turbine Dynamometer (MFP101a) 136

FRANCIS TURBINE

MFP101D

Reaction turbine for use with the Centrifugal Pump Module (MFP101).

- Optional turbine that fits on the Turbine Dynamometer (MFP101a) of the Centrifugal Pump Module (MFP101)
- Reaction turbine
- Ten-blade runner
- Fully adjustable guide vanes



The turbine has adjustable guide vanes that control the water flow in the turbine. They also direct the water at an angle to the blades of the impeller. Students learn how the guide vane setting affects how the turbine works. The turbine has a clear viewing window and draft tube so that students can see the turbine working.

LEARNING OUTCOMES:

- Variation of turbine performance with inlet pressure and flow rate
- Variation of turbine performance with speed
- Non-dimensional performance characteristics

ESSENTIAL BASE UNIT:

- Centrifugal Pump Module (MFP101) 135
(with Universal Dynamometer MFP100) 134

ESSENTIAL ANCILLARIES:

- Turbine Dynamometer (MFP101a) 136

ALTERNATIVE PRODUCTS:

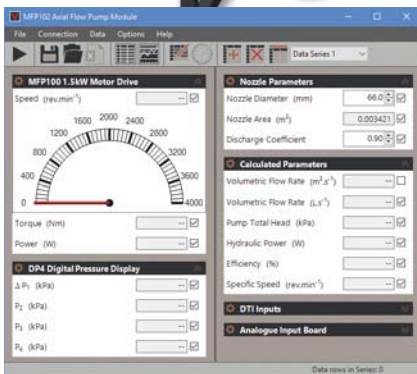
- Francis Turbine (H18) 126

AXIAL FLOW PUMP MODULE

VDAS[®] MFP102

Allows students to study and perform tests on an axial flow pump, to understand how it works and calculate its performance.

SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100)



SCREENSHOT OF THE OPTIONAL VDAS[®] SOFTWARE

- Axial flow pump, mounted in a mobile frame with full instrumentation, including a digital pressure display
- Self-contained – has its own water reservoir and needs no external water supply
- Part of TecEquipment's Modular Fluid Power range which connects with the Universal Dynamometer (MFP100) as a common motive-power source for a cost-effective solution
- Connection plate with schematic diagram shows the water flow circuit and how parts of the module connect to each other

LEARNING OUTCOMES:

- Variation of pump performance with speed
- Variation of pump performance with different outlet pressures and flow rate
- Non-dimensional performance curves
- Determination of the specific speed of the pump

The pump fitted to this module has two sections – one fixed and one moving, each with a set of blades. Water moves from a water tank through a calibrated nozzle. It then passes through the pump and down to a fully adjustable delivery valve. It then returns to the water tank. The delivery valve allows the user to gradually shut the downstream water flow for a range of pump performance tests.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 134

RECOMMENDED ANCILLARIES:

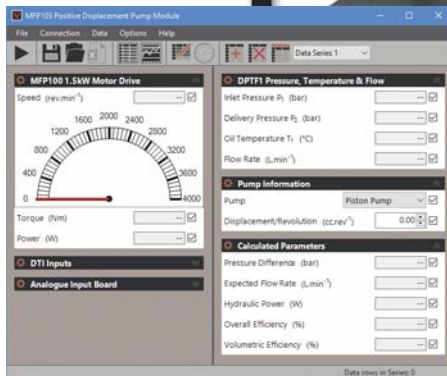
- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 299

POSITIVE DISPLACEMENT PUMP MODULE

VDAS[®] MFP103

Allows students to study and perform tests on a range of positive displacement pumps, to understand how they work and calculate their performance.

SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100) AND A PUMP



SCREENSHOT OF THE OPTIONAL VDAS[®] SOFTWARE

- Mobile pump-support module with full instrumentation
- Part of TecQuipment's Modular Fluid Power range which connects with the Universal Dynamometer (MFP100) as a common motive-power source for a cost-effective solution
- Allows students to study and test a range of popular positive displacement pumps (available separately)
- Connection plate with schematic diagram clearly shows oil flow circuit and how parts of the module connect to each other

The module consists of a mobile frame with an oil reservoir, a flowmeter, valves and instruments to measure pump performance. The flowmeter is a positive displacement unit, so that it still works correctly at any oil viscosity. Any of the optional pumps fit to the module. Two flexible, high-pressure pipes with quick-release, self-sealing connections connect the pump to the oil circuit.

AVAILABLE EXPERIMENT MODULES:

• Piston Pump (MFP103a)	141
• Gear Pump (MFP103b)	141
• Vane Pump (MFP103c)	142
• Swash Plate Pump (MFP103d)	142

NOTE: At least one of the optional pumps must be chosen to use with the Positive Displacement Pump Module. Tests or experiments cannot be performed without an optional pump.

ESSENTIAL BASE UNIT:

• Universal Dynamometer (MFP100)	134
----------------------------------	-----

RECOMMENDED ANCILLARIES:

• Versatile Data Acquisition System – Frame-mounted version (VDAS-F)	299
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PISTON PUMP

MFP103A

Piston pump for use with the Positive Displacement Pump Support Module (MFP103).

- Popular design, ideal for student experiments, demonstrations and projects
- Quick-release, self-sealing connections for simple and safe fitting
- Demonstrates the characteristics of a twin-piston pump

LEARNING OUTCOMES:

- Performance and characteristics of a piston pump
- Volumetric and overall efficiencies
- Use of an oval gear flowmeter

When two or more optional pumps are ordered:

- Comparison of positive displacement pumps (economy, flow rate and output pressure pulses)



The piston pump is a positive displacement pump. It has twin vertically-opposed pistons that deliver a given volume of fluid (oil) for each full rotation of the pump shaft.

ESSENTIAL BASE UNIT:

- Positive Displacement Pump Module (MFP103) 140
- (with Universal Dynamometer MFP100) 134

GEAR PUMP

MFP103B

Gear pump for use with the Positive Displacement Pump Support Module (MFP103).

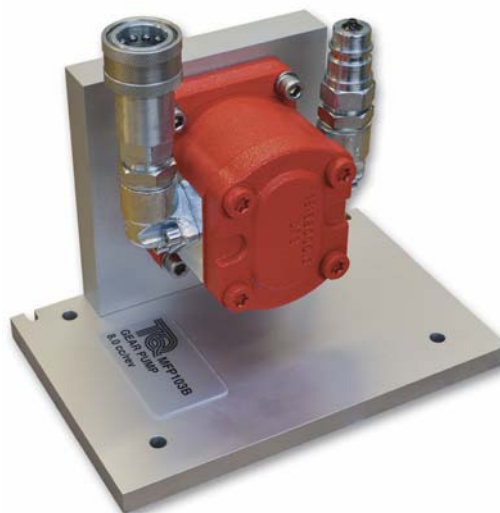
- Popular design, ideal for student experiments, demonstrations and projects
- Quick-release, self-sealing connections for simple and safe fitting
- Demonstrates the characteristics of a gear pump

LEARNING OUTCOMES:

- Performance and characteristics of a gear pump
- Volumetric and overall efficiencies
- Use of an oval gear flowmeter

When two or more optional pumps are ordered:

- Comparison of positive displacement pumps (economy, flow rate and output pressure pulses)



The gear pump is a positive displacement pump. It has double gears that deliver a given volume of fluid (oil) for each full rotation of the pump shaft.

ESSENTIAL BASE UNIT:

- Positive Displacement Pump Module (MFP103) 140
- (with Universal Dynamometer MFP100) 134

VANE PUMP

MFP103C

Vane pump for use with the Positive Displacement Pump Support Module (MFP103).

- Popular design, ideal for student experiments, demonstrations and projects
- Quick-release, self-sealing connections for simple and safe fitting
- Demonstrates the characteristics of a vane pump

LEARNING OUTCOMES:

- Performance and characteristics of a vane pump
 - Volumetric and overall efficiencies
 - Use of an oval gear flowmeter
- When two or more optional pumps are ordered:
- Comparison of positive displacement pumps (economy, flow rate and output pressure pulses)



The vane pump is a positive displacement pump. It has a fixed displacement balanced vane that delivers a given volume of fluid (oil) for each full rotation of the pump shaft.

ESSENTIAL BASE UNIT:

- Positive Displacement Pump Module (MFP103) 140
(with Universal Dynamometer MFP100) 134

SWASH PLATE PUMP

MFP103D

Swash plate pump for use with the Positive Displacement Pump Support Module (MFP103).

- Popular design, ideal for student experiments, demonstrations and projects
- Quick-release, self-sealing connections for simple and safe fitting
- Demonstrates the characteristics of a swash plate pump

LEARNING OUTCOMES:

- Performance and characteristics of a swash plate pump
 - Volumetric and overall efficiencies
 - Use of an oval gear flowmeter
- When two or more optional pumps are ordered:
- Comparison of positive displacement pumps (economy, flow rate and output pressure pulses)



The Swash Plate Pump is a positive displacement pump. It has a fixed displacement axial piston assembly that delivers a given volume of fluid (oil) for each full rotation of the pump shaft.

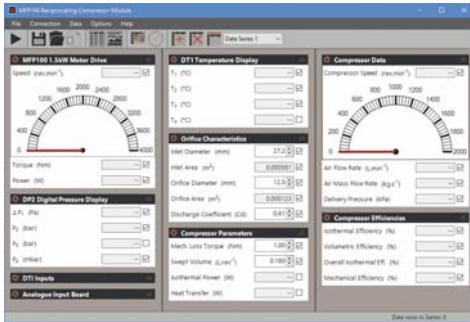
ESSENTIAL BASE UNIT:

- Positive Displacement Pump Module (MFP103) 140
(with Universal Dynamometer MFP100) 134

RECIPROCATING COMPRESSOR MODULE

VDAS® MFP104

Allows students to study and perform tests on a reciprocating compressor, to understand how it works and calculate its performance.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE



- Reciprocating compressor and air receiver mounted in a mobile frame with full instrumentation
- Allows students to study and test a popular fluid power machine
- Temperature and pressure measurements at key points in the system
- Connection plate with schematic diagram clearly shows how parts of the module connect together

LEARNING OUTCOMES:

- Energy balance for a compressor
- Variation of compressor performance with pressure
- Variation of compressor performance with speed
- Mechanical, volumetric and isothermal efficiencies
- Thermodynamics of a compressor

The module includes a small compressor with an air receiver and instrumentation, all mounted on a robust, mobile trolley for ease of use. Speed is fully variable up to the maximum allowable for the compressor. Air enters the compressor, which then delivers it under pressure to the receiver. A valve releases pressure from the receiver to atmosphere through an orifice. The valve sets the pressure in the receiver and hence the flow rate; the orifice allows an accurate measurement of the mass flow rate of the outlet air. These values help students to discover how the compressor flow rate relates to the pressure delivered by the compressor.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 134

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 299

ALTERNATIVE PRODUCTS:

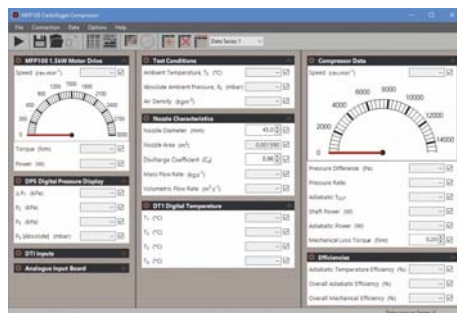
- Two-Stage Compressor Test Set (GT103) 268

CENTRIFUGAL COMPRESSOR MODULE

VDAS[®] MFP105

Allows students to study and perform tests on a centrifugal compressor, to understand how it works and calculate its performance.

- Centrifugal compressor, mounted in a mobile frame with full instrumentation
- Part of TecQuipment's Modular Fluid Power range that connects with the Universal Dynamometer (MFP100) as a common motive power source for a cost-effective solution
- Pressure and temperature measurements at key points in the system
- Connection plate with schematic diagram clearly shows the arrangement of the module



SCREENSHOT OF THE OPTIONAL VDAS[®] SOFTWARE

LEARNING OUTCOMES:

- Performance of a compressor
- Variation of compressor performance with speed
- Investigation of non-dimensional characteristics
- Comparison of performance with that of an ideal adiabatic system



The module consists of a compressor and instrumentation. Speed is fully variable up to the maximum allowable for the compressor. Air enters the compressor through a shaped nozzle, used to measure the air flow rate. The air then moves past a hand-operated delivery valve and out to atmosphere. The delivery valve controls the air flow rate (and therefore delivery pressure).

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 134

RECOMMENDED ANCILLARIES:

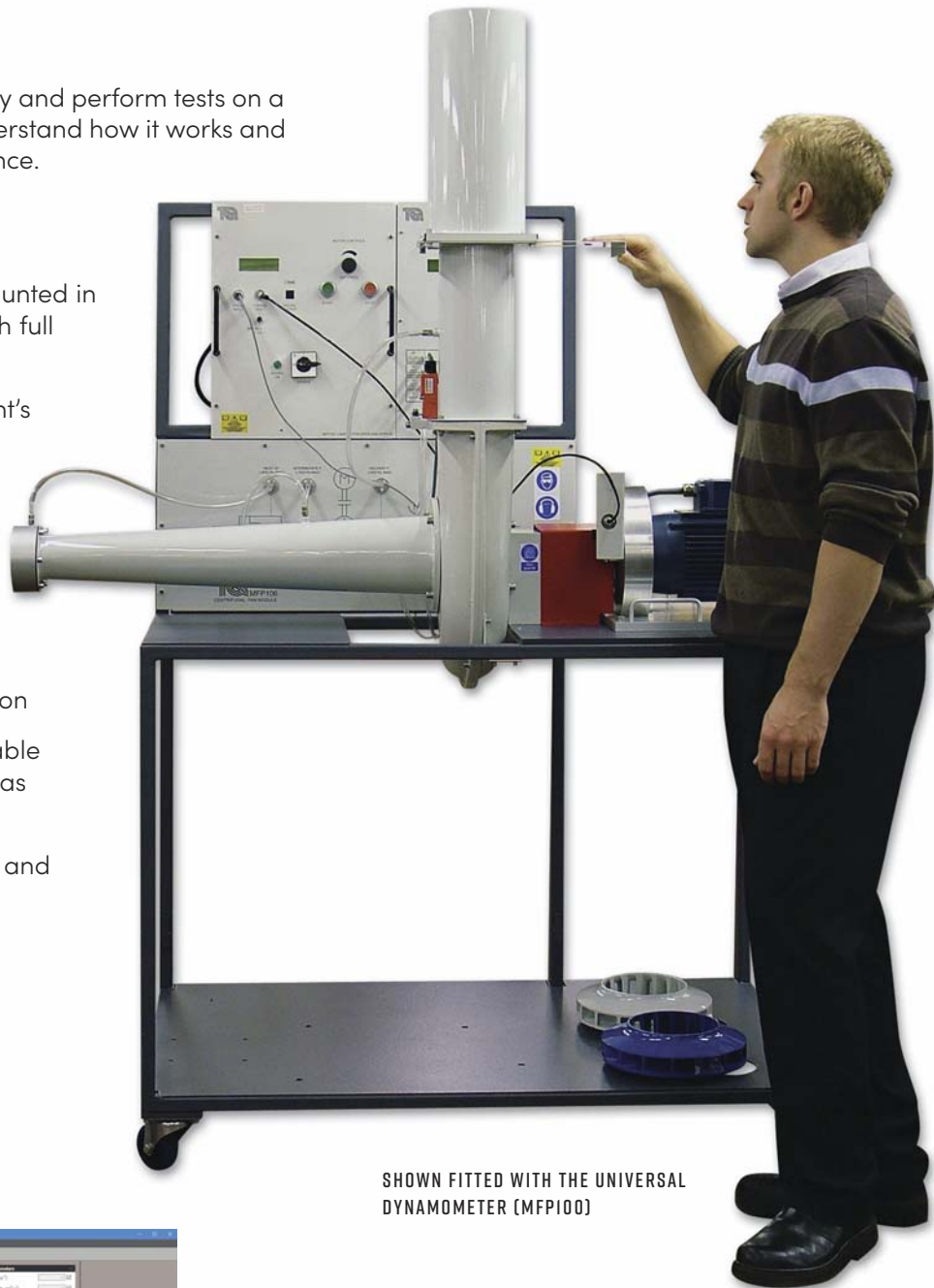
- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 299

CENTRIFUGAL FAN MODULE

VDAS® MFP106

Allows students to study and perform tests on a centrifugal fan, to understand how it works and calculate its performance.

- Centrifugal fan, mounted in a mobile frame with full instrumentation
- Part of TecEquipment's Modular Fluid Power range that connects with the Universal Dynamometer (MFP100) as a common motive power source for a cost-effective solution
- Three interchangeable impellers provided as standard
- Optional Pipe Flow and Nozzle Kit for more experiments



SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100)



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Performance of a centrifugal fan
- Variation of fan performance with speed
- Variation of fan performance with type of impeller
- Non-dimensional performance curves
- Determination of the specific speed of the fan

The module consists of a fan and instrumentation. Speed is fully variable up to the maximum allowable for the fan. Air enters the fan through a shaped nozzle, used to measure the air flow rate. The air then moves past a slide valve and out to atmosphere. The slide valve controls the air flow rate (and therefore delivery pressure). The fan impeller (moving part) is interchangeable. Supplied with the fan are three different impellers for more tests on fan performance.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 134

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 299
- Pipe Flow and Nozzle Kit (MFP106a) 146

PIPE FLOW AND NOZZLE KIT

MFP106A

Optional pipe flow and nozzle kit for use with the Centrifugal Fan Module (MFP106).



- Includes a multiway pressure display with additional instrument frame
- Includes different pipe fittings to compare losses in bends and elbows
- Axial probe and additional nozzle to find pressures along a nozzle
- Pitot traverse to find pressure profile and calculate theoretical flow
- Orifice plate to calculate theoretical flow and compare with the Pitot and standard nozzle measurement

LEARNING OUTCOMES:

- Axial pressure profile along a nozzle
- Velocity profile across a pipe
- Losses in straight pipes
- Losses in bends and elbows (fittings)
- Flow through an orifice

Optional Pipe Flow and Nozzle Kit for the Centrifugal Fan Module (MFP106). This kit includes two long lengths of smooth-walled pipe with multiple pressure tapings and a Pitot traverse. The pipes connect to the inlet of the MFP106 (the standard inlet nozzle is moved), so it becomes a suction fan for tests on the pipes. The pipe tapings connect to a multiway pressure display (supplied with the kit).

ANCILLARY FOR:

- Centrifugal Fan Module (MFP106)

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DIGITAL DATASHEETS

Visit individual product pages on the TecEquipment website to view and download the digital datasheets.

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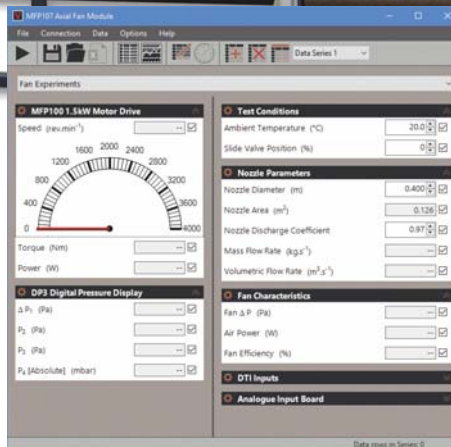
AXIAL FAN MODULE

VDAS® MFP107

Allows students to study and perform tests on an axial fan, to understand how it works and calculate its performance.



SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100)



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Part of TecQuipment's Modular Fluid Power range which connects with the Universal Dynamometer (MFP100) as a common motive-power source for a cost-effective solution
- Multiple pressure measurement points along the fan duct allow students to examine a full range of performance characteristics
- Connection plate with schematic diagram clearly shows air flow circuit and how parts of the module connect to each other
- Traversing, calibrated Pitot tube allows investigations of velocity distribution

LEARNING OUTCOMES:

- Characteristics of an axial fan, including head against flow efficiency
- Relationship between power and speed (power law)
- Velocity distribution in a round duct
- Calibration of an inlet nozzle
- Duct resistance and matching to fan to find operating point

The module has an axial fan mounted in a cylindrical steel duct. Air enters the duct through an inlet nozzle. The pressure at a set of tappings just downstream of the nozzle allows calculation of the inlet air flow rate. A slide valve (downstream of the fan) controls flow rate and delivery pressure. Air exits the duct through a silencer to reduce noise in the laboratory.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 134

RECOMMENDED ANCILLARIES:

- Pitot-Static Traverse – 450 mm (MFP107a) 148
- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 299

PITOT-STATIC TRAVERSE (450 MM)

VDAS® MFP107A

A traversing Pitot-static tube with electronic position measurement for use with TecQuipment's Axial Fan Module (MFP107)

The Pitot-Static Traverse allows students to find the velocity distribution across the duct of the Axial Fan Module (MFP107). This optional ancillary comprises a Pitot-static tube which fits on the duct of the Axial Fan Module and has a digital indicator to show the tube position across the duct.

ANCILLARY FOR:

- Axial Fan Module (MFP107) 147



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