

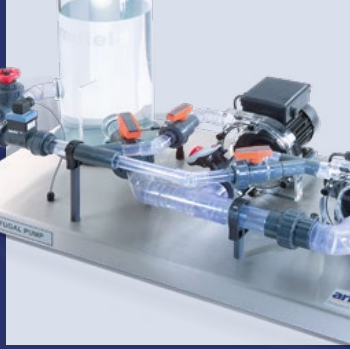
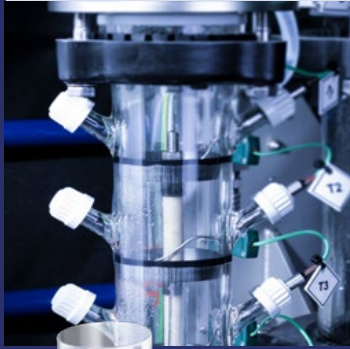
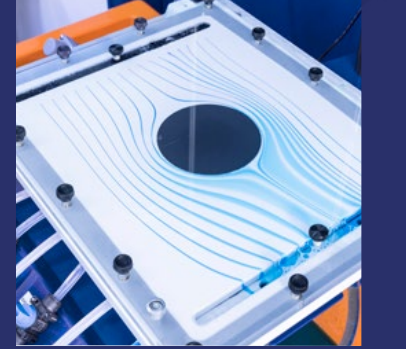
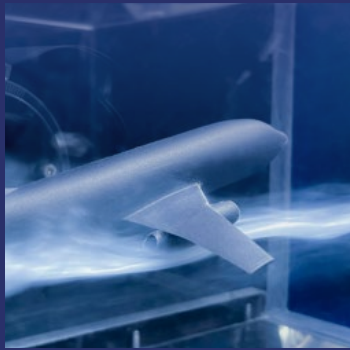
# armfield

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# ENGINEERING

teaching & research

CATALOGUE ISSUE 15



CHEMICAL/CIVIL/MECHANICAL/GEOSCIENCE/ENVIRONMENTAL/AGRICULTURAL/FOOD SCIENCE

Innovative engineering teaching, research and development equipment

**armfield**  
Part of Judges Scientific PLC

## Preface

**Since our inception in 1963 Armfield has been a proud and responsible provider of technical equipment.**

Today, Armfield is the world leader in the supply of innovative Education teaching and research equipment and Industrial Research & Development equipment for Food and Pharmaceutical laboratories.

People are at the core of our company: we see our strength in trust, diversity and progress. Every Armfield employee's contribution, no matter how big or small, forges the success of our organisation with the customer placed at the very heart of our business.

*As a business we take a market-based view in developing innovative and relevant products for our clients. This results in Armfield's mix of products and services being at the forefront of our sector. We embrace collaboration with our peers and end users by actively involving them in the design of our products.*

Our equipment allows users to educate, test and research in ways that fit their individual needs, while at the same time providing cost-effective, reliable and user-friendly products.

Armfield has built its reputation on a commitment to provide quality products and services, while rapidly responding to international needs for innovative and accurate educational and industrial equipment - complete with superior customer satisfaction.

With our focus on delivering credible, original equipment and content, we serve multiple markets throughout the world in the areas of High Schools, Universities, and Industrial Processing. We are leaders in Fluid Dynamics, Chemical, Civil, Mechanical Engineering, Food and Pharmaceutical Processing, while servicing the biggest names in food and beverage industries.

If you require more detailed data on any of the products contained within this catalogue, we are represented by a global network of agents, distributors and an international sales team who will be more than happy to support your requests.

*You will find our comprehensive list of agents and distributors on our website.*

### **Dr Sean Gregory**

Managing Director Armfield Limited





# ENGINEERING teaching and research

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# Fluid Mechanics



The Armfield Fluid Mechanics range plays a fundamental role in engineering teaching across multiple disciplines. The comprehensive range covers the complete curriculum requirement in Mechanical, Civil and Chemical Engineering with Food Technology encompasses subjects such as Hydrostatics and Properties of Fluids, Fluid Dynamics, Open Channel Flow (Free Surface Flow), Flow Around Bodies, Compressible Flow and Rotodynamic Machines.

## Hydrostatics and Properties of Fluids

The Armfield Hydrostatics portfolio offers a complete range of teaching equipment for the study of fluids at rest. Topics covered include Hydrostatics, Properties of Fluids, Static Pressure, Pressure Gauges and Manometers, buoyancy force and stability of floating bodies.



### Fluid Properties and Hydrostatic Bench - F902

Requirements

A practical instruction unit designed to demonstrate the properties of fluids and their behaviour under hydrostatic conditions.

With this apparatus students can develop their knowledge of a wide range of principles and techniques that will be of lasting value in their studies of fluid mechanics.

The equipment enables over 16 distinct experiments, is entirely self-contained, mobile, and independent of all laboratory services.

It includes a full range of ancillary equipment required for the experiments.



### Dead Weight Pressure Gauge Calibrator - F1-11

Requirements

The Dead Weight Pressure Gauge Calibrator consists of a precision-machined piston and cylinder assembly mounted on levelling screws.

The unit is supplied with a Bourdon gauge for calibration.

The weights supplied are added to the upper end of the piston rod, which is rotated to minimise friction effects. The gauge is thus subject to known pressures, which may be compared with the gauge readings and an error curve drawn.



### Precision Pressure Gauge Calibrator - F4

Requirements

The equipment is self-contained and portable, so it may be used in lecture theatre demonstrations or as a master calibrator for the laboratory.

The pressure in the system is produced by means of a capstan-operated hydraulic ram, balanced by a deadweight acting upon a piston of known area. Oil is used as the hydraulic fluid.

Meeting commercial standards, this laboratory dead weight calibrator is for gauges in the range 0.1-300bar. Accuracy is 0.03% of reading, traceable to International Pressure Standards.



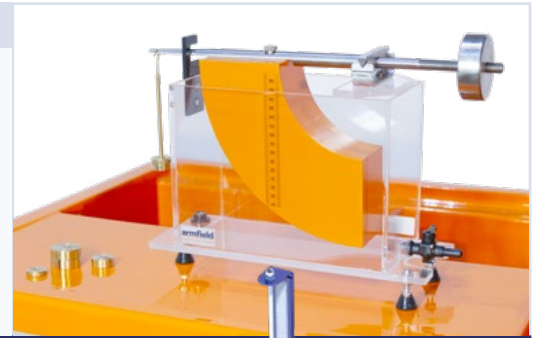


## Requirements

### Hydrostatic Pressure - F1-12



The Hydrostatic Pressure accessory has been designed to determine the hydrostatic thrust acting on a plane surface immersed in water when the surface is partially submerged or fully submerged. It also enables comparison of the measured magnitude and position of this force with the theoretical position.

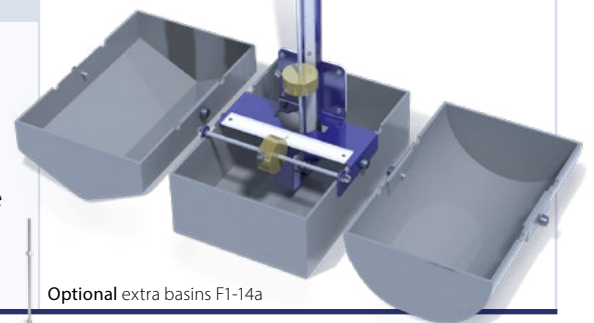


## Requirements

### Metacentric Height - F1-14-MKII



This unit allows the position of the metacentric height to be varied to produce stable and unstable equilibrium. The equipment consists of a plastic rectangular floating pontoon, for which centre of gravity can be varied by way of an adjustable weight, which slides and can be clamped in any position on a vertical mast. A single plumb-bob is suspended from the mast, which indicates the angle of heel on a calibrated scale.



Optional extra basins F1-14a

## Requirements

### Fluid Statics and Manometry - F1-29



The right-hand manometer tube is separate from the other tubes and incorporates a pivot and indexing mechanism at the base that enables this tube to be inclined at fixed angles of 5°, 30°, 60° and 90° (vertical). The reservoir incorporates a hook and point gauge with Vernier scale, mounted through the lid, that enables large changes in level to be measured with precision. A vertical transparent piezometer tube through the lid of the reservoir enables the static head above the water in the reservoir to be observed, when the air space above the water is not open to atmosphere.



## Requirements

### Fluid Properties Apparatus - F1-30



This apparatus provides an introduction to the fundamental properties of liquids that affect their behaviour in practical applications.

#### This unit includes:

- ▶ Universal hydrometer
- ▶ 2 calibrated falling-sphere viscometer tubes
- ▶ 3 steel spheres
- ▶ Thermometer
- ▶ Aneroid barometer
- ▶ 6 varying diameter capillary tubes
- ▶ Pycnometer and a dual scale level balance



## Requirements

### Pascal's Apparatus - F1-31



The Pascal's Apparatus provides a simple but effective demonstration that the intensity of pressure in a liquid depends only on the depth of the liquid and not on the shape of the vessel, container, reservoir etc. By comparing the pressure/force at the base of three vessels with different shapes when filled to the same depth with water.



# Fluid Mechanics - F Series

Link to F1 Series



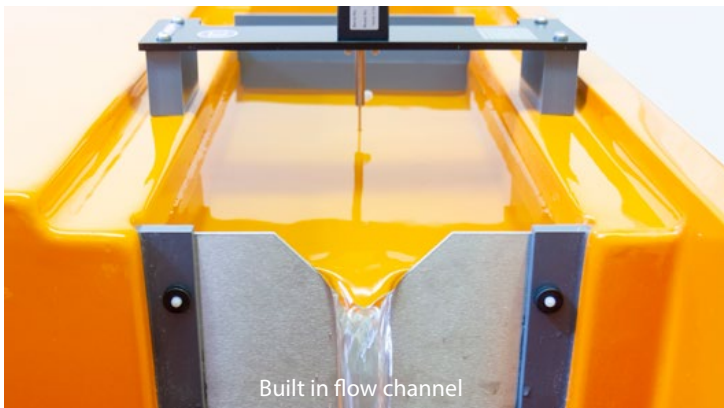
## Fluid Dynamics

The Armfield Fluid Dynamics range covers the complete curriculum requirement of fluids in motion for Chemical, Mechanical and Civil Engineering.

The range includes studies into the various properties of fluids, such as velocity, pressure, conservation laws of mass, energy and momentum.



F1-13 Flow Over Weirs



Built in flow channel



Optional Digital Flow Meter

### Basic Hydraulics Bench - F1-10 (Factory fit, digital flow meter option shown)

The Armfield Hydraulics Bench and its comprehensive range of optional accessories have been developed to instruct students on the many different aspects of hydraulic theory.

Each accessory to the F1-10 is supplied as a complete piece of equipment needing no additional service items other than the Hydraulics Bench. When coupled with the bench they are immediately ready for use.

- ▶ Fluid Mechanics Software F1-aBASIC included as standard
- ▶ The GRP bench top incorporates an open flow channel with weir carrier and ledges along both sides to support appropriate accessories on test
- ▶ Quick-release pipe connector for rapid exchange of accessories, no need for hand tools
- ▶ The volumetric measuring tank is stepped to accommodate low or high flow rates
- ▶ Optional F1-10-1 External Flowmeter accessory for existing F1-10 bench's available
- ▶ Optional F1-10-2 Hydraulics Bench with integrated digital flow meter available

#### Requirements

- 1Ph
- PC
- COLD





## Requirements

### Bernoulli's Theorem Demonstration - F1-15

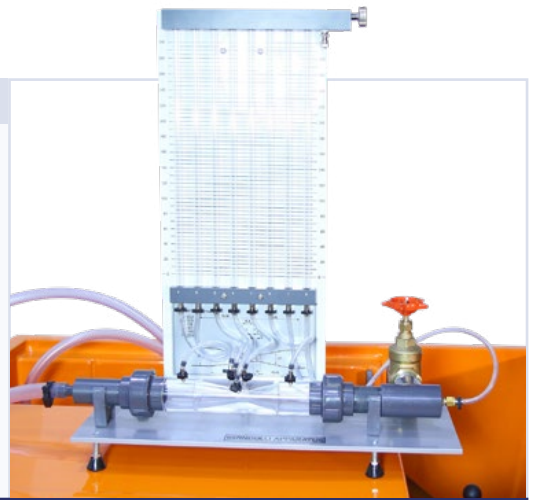
F1-10

The Bernoulli's Theorem Demonstration Apparatus consists of a classical Venturi shape machined from clear acrylic. A series of wall tapings in the longest taper allows measurement of static head changes as the cross section varies.

A total head tube can be traversed along the centreline of the test section to obtain total head readings at any location along the test section.

The apparatus enables students to investigate the validity of the Bernoulli equation when applied to the steady flow of water in a converging or a diverging duct.

The test section can be reversed to show applications where the Bernoulli equation applies and applications where it breaks down because of frictional losses.



## Requirements

### Impact of a Jet - F1-16-MKII

F1-10

The Impact of Jet Apparatus, consists of clear acrylic test cylinder, into which water is fed vertically through a nozzle. The water strikes a target mounted on a stem. A weight pan mounted at the top of the stem allows the force of the water to be counterbalanced by applied masses.

The F1-16-MKII allows students to investigate the reaction forces produced by the change in momentum of a fluid flow, by measurement of the forces produced by a jet impinging on solid surfaces which produce different degrees of flow deflection.

► New models included



## Requirements

### Orifice and Free Jet Flow - F1-17

F1-10

The Orifice and Jet Apparatus, consists of a reservoir of water with an orifice plate (3mm or 6mm) set into it. A jet of water issues from this hole and its trajectory may be measured using 8-point gauges to determine the discharge coefficient.

The F1-17 allows students to determine the coefficient of velocity by measurement of the trajectory of a jet issuing from an orifice in the side of a reservoir under steady flow conditions (constant reservoir head).



## Requirements

### Orifice Discharge - F1-17a

F1-10

The Orifice Discharge accessory enables full analysis of the flow through different orifices over a range of flow rates.

**It consists of:**

- Seven orifice plates
- A cylindrical clear acrylic tank, with an orifice fitted in the base
- A carrier enables a pitot tube to be accurately positioned anywhere in the jet
- A wire micrometre is used to accurately measure the jet diameter and the vena contracta diameter and so determine the contraction coefficient



Updated



## Energy Losses in Pipes - F1-18

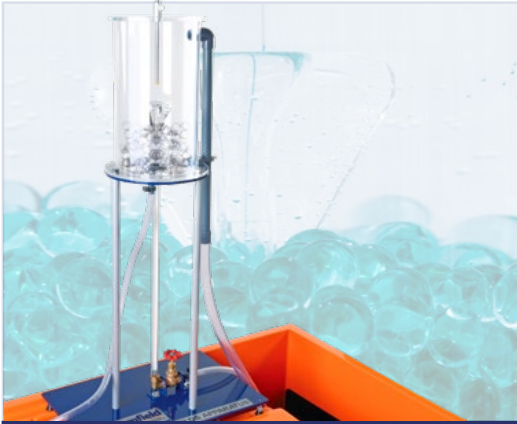
The Energy Losses in Pipes accessory consists of a test pipe, orientated vertically on the side of the equipment, which may be fed directly from the hydraulics bench supply or, alternatively, from the integral constant head tank.

These sources provide high or low flow rates which can be controlled by a valve at the discharge end of the test pipe. Head loss between two tapping points in the test pipe is measured using two manometers, digital handheld manometer for large pressure differentials and a pressurised water manometer for small pressure differentials.

Excess water discharging from the constant head tank is returned to the sump tank of the hydraulics bench.

Requirements

F1-10



## Osborne Reynolds' Demonstration - F1-20

The Osborne Reynolds' apparatus is a classic experiment and is a visualisation of flow behaviour by injection of dye into a steady flow in a pipe.

The apparatus enables students to observe laminar, transitional, and turbulent pipe flow.

A header tank containing stilling media provides a constant head of water through a bellmouth entry to the flow visualisation pipe. Flow through this pipe is regulated using a control valve at the discharge end.

The flow rate can be measured using the volumetric tank (or measuring cylinder) of the Hydraulics Bench. Velocity of the water can therefore be determined to enable calculation of Reynolds' number.

Requirements

F1-10



## Flow Meter Demonstration - F1-21

The Flow Meter demonstration unit consists of a Venturi meter, a variable area meter and an orifice plate installed in a series configuration to allow for direct comparison.

The apparatus allows students to investigate the operation and characteristics of three different basic types of flowmeter.

This includes accuracy and energy losses, by measurement of volume flow rates and associated pressure losses with three flowmeters connected in series and using timed volume collection to produce a reference measurement of flow rate.

Requirements

F1-10



## Energy Losses in Bends and Fittings - F1-22

This accessory permits losses in different bends, a sudden contraction, sudden enlargement and a typical control valve, to be demonstrated.

- ▶ Mitre bend - 90° elbow - Swept bends (large and small radius)
- ▶ Sudden contraction and sudden enlargement

Fully Instrumented with upstream and downstream pressure tappings.

A bank of 12 water manometer tubes, mounted on the framework for visualisation of the pressure drop profiles.

Requirements

F1-10





## Requirements

### Free and Forced Vortex - F1-23-MKII

F1-10

The Free and Forced Vortex equipment is designed to produce and measure the characteristics of free and forced vortices.

It enables students to determine the surface profile of a forced vortex, and compare with theoretical values, by measuring the speed of rotation and length of needles that represent the forced vortex.

Coupled with the ability to measure the profile of a free vortex, and investigate the changes in velocity head throughout the vortex. By employing the Pitot tubes and measuring the elevation of water in the cylinder at different radius of the vortex.



## Requirements

### Hydraulic Ram - F1-24

F1-10

If flowing water is suddenly brought to rest in a long pipe, a phenomenon known as water hammer occurs, which produces a pressure wave that travels along the pipe.

This principle is used in the hydraulic ram to pump water. The Hydraulic Ram Pump apparatus consists of a base unit incorporating two fluid chambers, pulse and non-return valves and a supply reservoir on a stand.

The unit allows students to demonstrate the operating principles of the hydraulic ram.



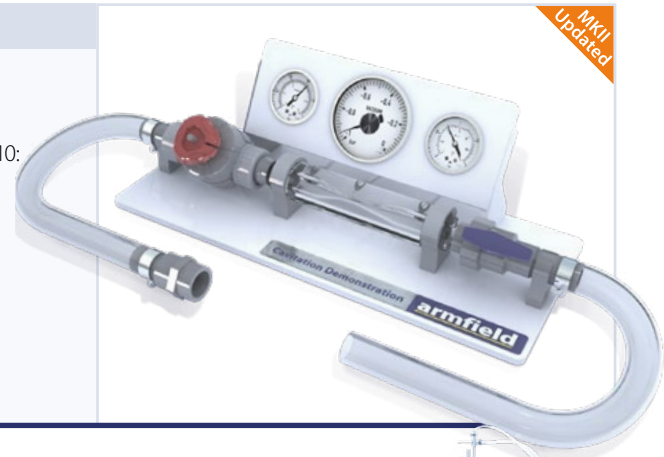
## Requirements

### Cavitation Demonstration - F1-28

F1-10

The Cavitation Demonstration Apparatus, demonstrates to students visually, audibly and numerically the phenomenon of cavitation and its association with the vapour pressure of a liquid. The following demonstrations are possible using the F1-28 in conjunction with the F1-10:

- ▶ Observation of the phenomenon of cavitation in a liquid (by reducing the static pressure of the liquid to its vapour pressure)
- ▶ Comparison of theoretical and actual pressure at cavitation conditions
- ▶ Observation of air-release due to free and dissolved gasses in a liquid
- ▶ Demonstration of reducing cavitation by increasing the static pressure in a liquid



## Requirements

### Pitot Tube Demonstrator - F1-33

F1-10

The Armfield unit is designed to demonstrate the operation and characteristics of a Pitot-static tube that is used to determine fluid velocity by measuring the difference between the total head and the static head of water flowing inside a pipe using a manometer.

A series of simple teaching exercises show how the Pitot-static tube works, how it can be used to measure fluid velocity using an appropriate instrument to measure differential head and how Velocity head and therefore fluid velocity varies across the diameter of a pipe.

The rigid horizontal cylindrical pipe, incorporating the Pitot-static tube, is constructed from clear acrylic and PVC for durability and ease of maintenance. The Pitot-static tube can be traversed across the diameter of the pipe to show changes in dynamic head profile inside the pipe.

Shown with the F1-10 Bench





F1-13a Advanced Weirs

## Flow Over Weirs - F1-13-MKII/F1-13a

The Flow Over Weirs accessory is used in conjunction with the flow channel in built to the Hydraulics bench. The apparatus demonstrates the characteristics of flow and the relationship between upstream water level and weir discharge for various notches.

### F1-13-MKII Flow Over Weirs

Stilling Baffle And Inlet Nozzle  
 Vernier Hook And Point Gauge And Instrument Carrier  
 Large Notch Plate Weir 30mm  
 Large Notch Plate Weir 50mm  
 Large V Plate Weir 90°  
 Regular V Plate Weir 90°

### F1-13a Advanced Weirs

Large Trapezoidal Weir 30mm  
 Large Trapezoidal Weir 50mm  
 Large V Plate Weir 30°  
 Dog Bone Weir

Requirements

F1-10



## Flow Channel - F1-19

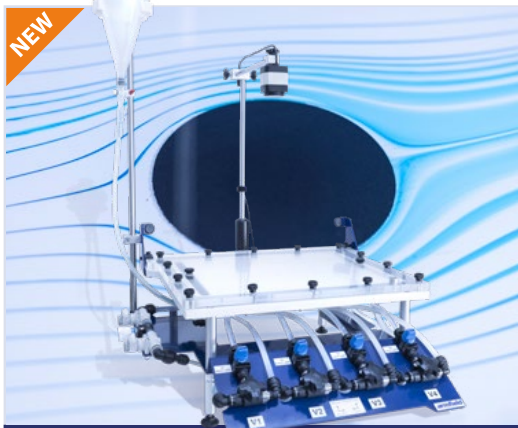
The Flow Visualisation Apparatus consists of a perspex channel with a large depth to width ratio, which is fed with water, into which dye may be injected.

This apparatus allows students to achieve two objectives:

- ▶ To visualise a range of open-channel flow behaviour, by creating flow phenomena in an open channel, using an undershot weir, overshoot weir, sharp-edged and broad-crested weirs including both super-critical (fast) and sub-critical (slow) behaviour
- ▶ To visualise flow patterns around immersed objects in steady flow by creating a relatively low Reynolds number and quasi-2-dimensional flow around models located in a narrow channel
- ▶ To visualise the flow patterns by dye streak lines, which in steady flow are the same as streamlines

Requirements

F1-10



NEW

## Hele Shaw Apparatus - F1-38

The Hele Shaw Apparatus provides a very visual means of showing potential flow in the field of fluid dynamics. The water flows through a very narrow channel which is formed between two plates causing the water to flow in a special way.

The mean velocity of the water along the channel obeys equations as those for local velocity in potential flow. The water flow within the channel is designed to be in a steady, laminar state.

This apparatus is supplied with models and blank material to create your own:

- ▶ Venturi half X2
- ▶ Orifice plate half X2
- ▶ Disc
- ▶ Aerofoil NACA633-618
- ▶ Aerofoil Gottingen 535
- ▶ Blank material

Requirements

F1-10



## Particle Drag Coefficients - F12

A wall mounted apparatus in which particles of various size and density can be used to introduce the fundamental characteristics of the behaviour of particle/fluid systems. In particular, the relationship between the drag coefficients of falling particles and their Reynolds' number value.

- ▶ Compact, wall mounted apparatus to study the behaviour of particles and shapes within fluids
- ▶ 2 x Ceramic Spheres (One off each: 6.35mm and 9.5mm Diameter)
- ▶ 4 x Stainless Steel Spheres (One off each: 3.17mm, 6.35mm, 7.9mm and 9.5mm Diameter)

Requirements

1Ph





## Rotodynamic Machines

The Rotodynamic Machines range from Armfield introduces students to kinetic machines in which energy is continuously imparted to the pumped fluid by means of a rotating impeller, propeller, or rotor.

The range also offers a comparison with positive displacement pumps.



### Requirements

#### Demonstration Pelton Turbine - F1-25

F1-10

The Demonstration Pelton Turbine provides a simple low cost introduction to turbine performance.

The unit consists of:

- ▶ Turbine wheel inside cast housing with acrylic panel to enable viewing
- ▶ Mechanical torque measured using dynamometer with spring balances
- ▶ Inlet pressure gauge
- ▶ Quick-release fitting for easy connection to Hydraulics Bench

(Option) 100 2/1 Tachometer

### Requirements



NY11 Updated

### Requirements

#### Demonstration Francis Turbine - F1-32

F1-10

This demonstration turbine provides an introduction to the Francis inward flow reaction turbine.

The unit consists of:

- ▶ Francis runner surrounded by six guide vanes inside a volute with clear acrylic front panel for visualisation
- ▶ Guide vanes adjustable when turbine is running with scale to indicate degree of opening
- ▶ Francis runner 60mm diameter with 12 blades
- ▶ Brake force determined using Prony-type brake dynamometer
- ▶ Inlet pressure gauge with range 0-2 bar

(Option) 100 2/1 Tachometer



### Requirements

#### Centrifugal Pump Characteristics - F1-27

1Ph

F1-10

The Centrifugal Pump Characteristics Accessory, used in conjunction with the sump tank and volumetric tank on the F1-10 bench demonstrates the characteristics of a single centrifugal pump by the measurement of the pump head, discharge and power characteristics at varying speeds.

The speed of the pump on F1-27 can be varied to demonstrate the characteristics of two dissimilar pumps when connected in series or parallel.



### Requirements

#### Series/Parallel Pumps - F1-35

1Ph

F1-10

The Series/Parallel pumps accessory is used to demonstrate the head/flowrate characteristics of a centrifugal pump for several different configurations, by measurement of pressure at pump inlet and outlet and discharge flowrate.

The F1-35 Series / Parallel pumps apparatus enable students to gain an understanding of the following pump theory:

- ▶ Series Pump Operation, that pumps can be combined in series to obtain an increase in head at the same flowrate as the single pump
- ▶ Parallel Pump Operation, that pumps can be combined in parallel to obtain an increase in flowrate at the same head as the single pump



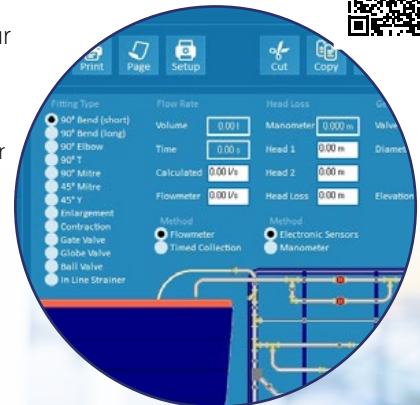
## Fluid Dynamics

### The Armfield C6-MKII-10 Fluid Friction Measurements

This unit provides facilities for the detailed study of fluid friction head losses, which occur when an incompressible fluid flows through pipes, fittings and flow metering devices.

A wide range of measurements, demonstrations and training exercises are possible:

- ▶ Confirming the relationship between head loss due to fluid friction and velocity for flow of water
- ▶ Determining the head loss associated with flow through a variety of standard pipe fittings
- ▶ Determining the relationship between pipe friction coefficients and Reynolds' number for flow through a pipe with roughened bore
- ▶ Demonstrating the application of differential head devices in the measurement of flow rate and velocity
- ▶ Providing practical training of pressure measurement techniques
- ▶ Enhancing understanding of the hydraulic principles involved through the use of complementary computer software



C6-MKII-DTA-ALITE software (optional)



### Fluid Friction Measurements - C6-MKII-10

The Armfield Fluid Friction Measurements unit provides facilities for the detailed study of fluid friction head losses, which occur when an incompressible fluid flows through pipes, fittings and flow metering devices.

Armfield recommend the use of a water manometer for the low-pressure measurements and an electronic pressure meter for the high-pressure measurements.

- ▶ H12-2: Liquid manometer (water)
- ▶ H12-8: Portable pressure meter (electronic)

Also available for use with data acquisition instruments is a software package, which performs all the necessary calculations from readings entered manually.

- ▶ C6-MKII-ABASIC: Educational software for fluid friction measurements (manual data entry)
- ▶ C6-MKII-DTA-ALITE: Computer Data Capture Unit (Automatic Data Acquisition)

#### Requirements

- F1-10
- PC
- USB





## Requirements

### Multi-Pump Test Rig - C3-MKII

1Ph

PC

USB

The rig can accommodate both rotodynamic and positive displacement pumps, and is supplied with the most common example of each type as standard (a centrifugal pump and a gear pump). A range of other pump types are available as accessories, including axial, turbine, flexible impeller, diaphragm and plunger; plus a second centrifugal pump for series/parallel demonstrations.

Up to four pumps can be accommodated within the rig simultaneously for use within a single laboratory period, and each can be run without disconnecting any pipework or connections.

ArmSoft Educational software and data logging hardware as standard.

**C3-MKII-20** Centrifugal Pump (Supplied as standard)

**C3-MKII-20SP** Second Centrifugal Pump

**C3-MKII-21** Gear Pump (Supplied as standard)

**C3-MKII-22** Axial Flow Pump

**C3-MKII-23** Flexible Impeller Pump

**C3-MKII-24** Turbine Pump

**C3-MKII-25** Diaphragm Pump (requires C3-MKII-40)

**C3-MKII-26** Plunger Pump (requires C3-MKII-40)

**C3-MKII-40** Volumetric Measurement System



Software inc

## Requirements

### Pipe Surge & Water Hammer Apparatus - C7-MKII

F1-10

PC

USB

The Armfield Pipe Surge and Water Hammer Apparatus contains two independent pipe systems: one demonstrates pipe surge and the use of a surge shaft to attenuate changes in pressure following slow changes to the flow in a system, the other pipe system allows a detailed examination of the shock waves (Water Hammer) generated by rapid changes to the flow in a system such as a valve closing quickly.

A single USB connection to a PC (not supplied) provides power for the three pressure transducers on the unit and allows the readings from the pressure transducers to be recorded and stored using the PC. Data logging software allows the relatively slow oscillations in the surge shaft to be viewed in real time and stored for analysis.

A virtual oscilloscope allows the rapid changes in pressure, associated with water hammer, to be viewed for analysis after the event due to the short duration of pressure transients following operation of the fast-acting valve.



Software inc

## Requirements

### Pipe Networks Accessory - C11-MKII

F1-10

Pipe Networks Accessory is specifically designed to allow the study of a wide range of different pipe networks.

The unit consists of:

- ▶ Pipe network mounted on free standing support frame
- ▶ Inside diameters of 1x 6mm, 2x 9mm, 1x 10mm, 1x 14mm
- ▶ Clear acrylic test pipes all 0.70m long
- ▶ 10 Isolating valves
- ▶ Hand-held electronic pressure meter with self-sealing quick-release connections



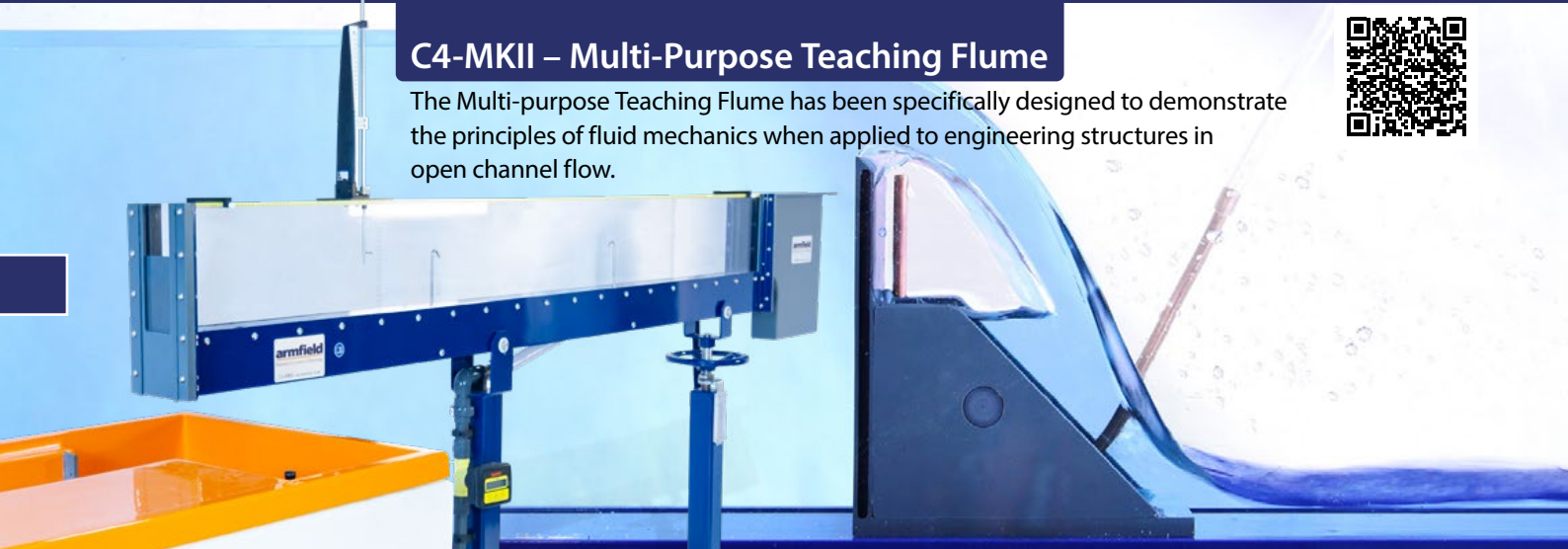
## Fluid Mechanics - C Series

Link to C4-MKII



### C4-MKII – Multi-Purpose Teaching Flume

The Multi-purpose Teaching Flume has been specifically designed to demonstrate the principles of fluid mechanics when applied to engineering structures in open channel flow.



#### Multi-Purpose Teaching Flume - C4-MKII-10

- C4-MKII-11 - With Flow Meter

A low cost laboratory flume with an experimental range and accuracy comparable with larger-scale research flumes. Students can clearly see the models under investigation through the transparent side walls. A wide selection of open channel experiments can be performed.

A set of models and gauges are provided with the flume as standard:

- ▶ Venturi flume
- ▶ Sharp and broad crested weirs
- ▶ Crump weir
- ▶ Adjustable undershot weir
- ▶ Two Vernier level gauges

Available in 2.5m and 5.0m working section lengths.

Optional educational software is available (C4-MKII-ABASIC) offering a complete teaching package of coursework.

Requirements

F1-10

PC

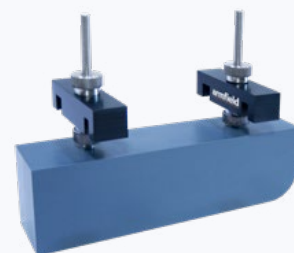


Set of models provided with the flume as standard



#### Additional C4-MKII accessories:

- C4-61 Pitot Tube and Manometer Board
- C4-62 Culvert Fitting
- C4-63 Flow Splitters
- C4-64 Spillway and Toe Blocks
- C4-65 Siphons (2 types)
- C4-66 Radial Gate Model
- C4-67 Wave Generator and Beach
- C4-68 False Floor Sections
- C4-69 Roughened Bed Plates, 2.5m long
- C4-MKII-ABASIC Teaching Software For Multi-Purpose Flume



Requirements

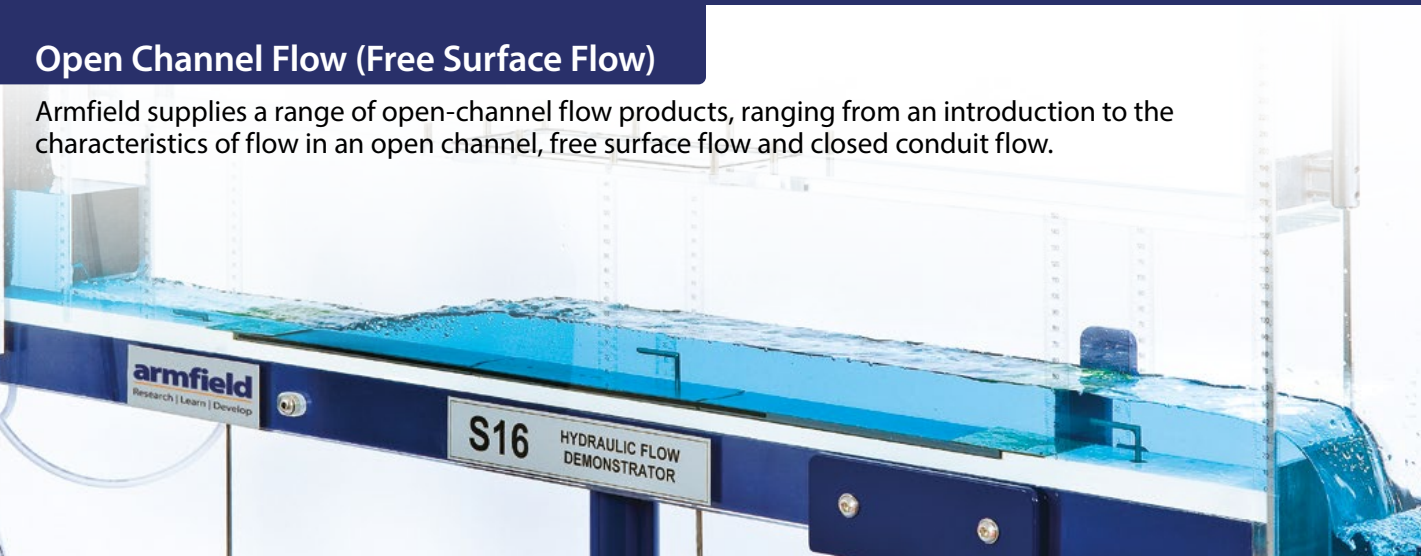
C4-MKII





## Open Channel Flow (Free Surface Flow)

Armfield supplies a range of open-channel flow products, ranging from an introduction to the characteristics of flow in an open channel, free surface flow and closed conduit flow.



Requirements

### Hydraulic Flow Demonstrator - S16

F1-10

The operates as an accessory to the F1-10 Hydraulics Bench, offering a highly visual demonstration of flow through both open channels and closed conduits. Includes a unique elevating bed section, and models of various hydraulic structures.

#### Hydraulic Flow Demonstrator - S16-11 (direct reading flowmeter)

Covers both fluid dynamics and open channel flow topics:

- ▶ Demonstrate flow through both open channels and closed conduits
- ▶ Unique elevating bed section
- ▶ Models of various hydraulic structures demonstrating critical flow and energy changes
- ▶ Clear acrylic sides for good visibility of flow patterns created



Requirements

### Laminar Flow Table - C10



Enables comprehensive grid measurement and photography of two dimensional laminar flow patterns in incompressible fluids.

The equipment extends the classical Hele-Shaw approach by including eight sinks and sources, plus a dye injection system, enabling flow patterns to be seen more vividly.



Requirements

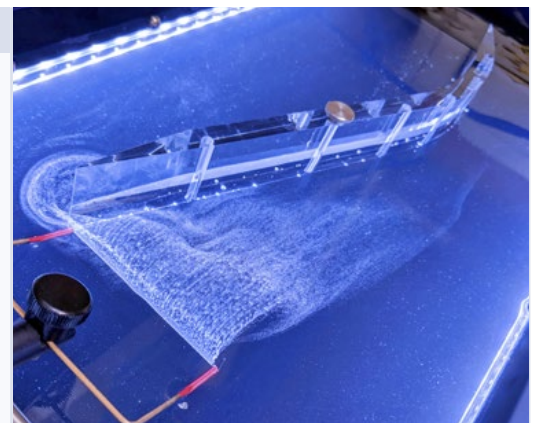
### Hydrogen Bubble Flow Visualisation System - C16

1Ph

An elegant method of flow visualisation, where hydrogen bubbles are used to visualise fluid mechanics phenomena so difficult to describe theoretically.

The system utilises a unique fluid drive unit to provide smooth flow in the working channel.

An optional high resolution firewire webcam can be used to link to projectors or displays for large-scale presentations.



## Fluid Mechanics - C Series

### Compressible Flow

The Armfield Compressible Flow range covers the branch of fluid mechanics that studies flows having significant changes in fluid density at constant volume flow and a varying volume flow.



#### Air Flow Studies - F6

The movement of air is a concept which relates to many disciplines in engineering. The losses incurred in pipes or ducts, the losses in associated fittings and measurement of the air flows involved form a basic part of most engineering courses.

The Armfield Air Flow Studies apparatus is a self-contained unit, providing a long, smooth-walled pipe connected to the suction inlet of a centrifugal fan, is used to demonstrate how to measure important characteristics of industrial air distribution systems. It can also show how certain principles of fluid mechanics may be applied to analyse flow in ducts and jets the unit incorporates the following experiments:

- ▶ Dispersion of a jet
- ▶ Boundary layer growth in pipe flow
- ▶ Discharge measurement by orifice plate meter
- ▶ Head losses in bends and elbows
- ▶ Inlet nozzles used as flowmeters

Optional Data logging accessory H14/2 available

Requirements



#### Compressible Flow Unit - C1-MKIII

A versatile apparatus, based around a multi-stage air compressor, designed to teach the concepts of compressible flow.

The basic unit contains all that is required to demonstrate the fundamental principles - but an accessory is also available, containing a number of interchangeable test sections to give a wider knowledge and understanding to the student.

**Additional Test Sections - C1-MKIII-30** (Option)

**Compressor Test Accessory - C1-MKIII-35** (Option)  
Compressor performance tests

Requirements



PC

USB





C9-MKII-8 Variable Area Flowmeter

## C9-MKII Flowmeter Demonstrator

The C9-MKII Flowmeter Demonstrator is designed to allow the user to understand the different types of flowmeters commonly found in use throughout various industries.

The experimental content includes the measurement of pressure loss across a range of flowmeters and the direct use of flowmeters for the determination of flowrates, either visually or by the use of a pressure differential. The unit is supplied with armBUS software (manual data entry for non-electronic flow meters, automatic datalogging for electronic flow meters (Requires AIU-4)) as standard.

C9-MKII-2 Ultrasonic Flowmeter



C9-MKII-3 Venturi Nozzle



C9-MKII-4 Pitot Tube



C9-MKII-5 Orifice Plate Flowmeter



C9-MKII-6 Paddle Wheel Flowmeter



C9-MKII-13 Baffle Plate Flowmeter



C9-MKII-7 Turbine Wheel Flowmeter



C9-MKII-10 Vortex Flowmeter



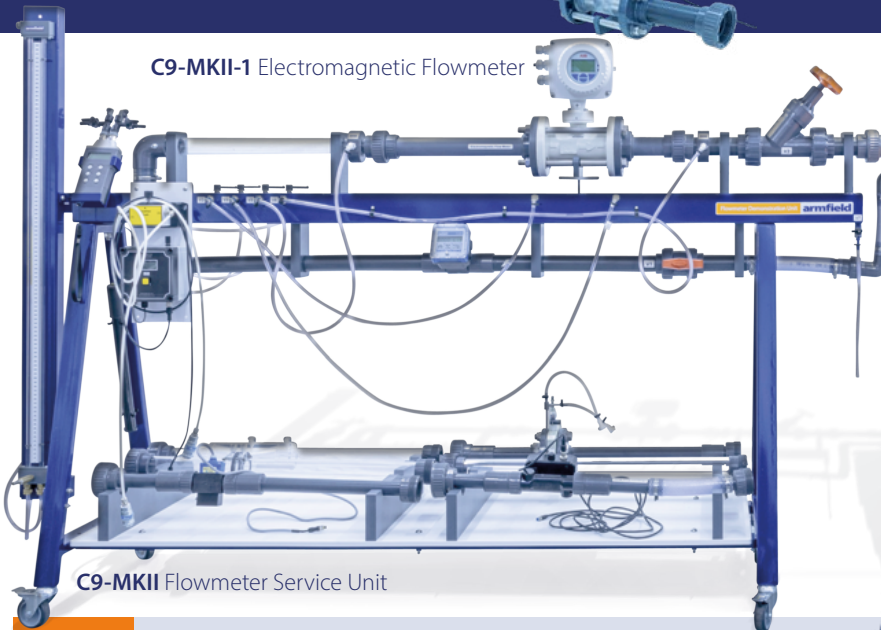
C9-MKII-11 Orifice Plate Flowmeter with Transducer



C9-MKII-12 Bypass Flowmeter



C9-MKII-1 Electromagnetic Flowmeter



C9-MKII-9 Variable Area Flowmeter with Transducer



F1-10 Hydraulics Bench

AIU-4 Interface Unit

Software  
inc

### Requirements

1Ph

PC

USB



### Comprehensive Flow Meter Demonstration - C9-MKII

The flowmeters available are of both electronic and non-electronic types with the options covering both mechanical and passive systems.

#### Features & Benefits:

- ▶ Modular flowmeter demonstration unit optionally supplied with 13 flowmeters
- ▶ Allows students to understand the advantages and disadvantages of various flowmeters
- ▶ Assess the pressure drop which occurs with flowmeters within a simple piped system
- ▶ Understand the practical use and characteristics of industrial flowmeters
- ▶ Supplied with armBUS software as standard
- ▶ Understand flow measurement by using flowmeters which rely on a pressure change across the system
- ▶ Utilises Armfield F1-10 Hydraulics Bench



**C**  
SERIES

# Advanced Fluid Mechanics



Covering the complete curriculum requirements of fluid in motion for Chemical, Mechanical and Civil Engineering.

The range includes studies into the various properties of the fluid, such as velocity, pressure, conservation laws of mass, energy and momentum.



The Armfield **C30-Subsonic Wind Tunnel** enables the user to carry out advanced studies in the aerodynamics fields including boundary layer experiments, flow visualisation, pressure distribution, study of turbulence and offering the possibility of developing self-design aerodynamics profiles to be tested.

The wind tunnel comprises outstanding features such as computer control, up to 40m/s flow velocity, remote operation, datalogging and diagram plotting in real time.

*Note: Most accessories are available for both the C30 and C15 wind tunnels*



C30 - Computer Controlled Subsonic Wind Tunnel



**NEW**

## Computer Controlled Subsonic Wind Tunnel - C30

The Wind Tunnel is a computer controlled subsonic wind tunnel designed for undergraduate teaching.

It has a 600mm long (23.6 inches) transparent working section and offers a wide range of models for aerodynamic and air flow studies.

An extensive range of models, accessories & instrumentation is available for the C30.

### Requirements

PC

USB

≤ 1Ph

F-16 Airplane Model - C30-40



Software inc



Requirements

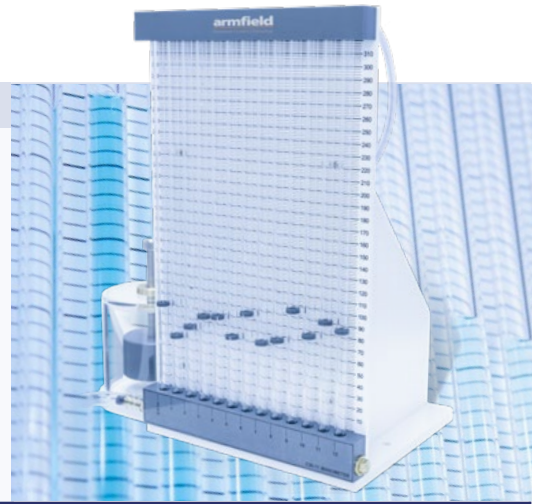
**Inclined Manometer Bank - C30-11**

C30

A bank of 13 transparent tubes positioned vertically to measure small pressure differences (0 – 320 mm H<sub>2</sub>O) using water as the working fluid for safe operation and convenience in use.

The C30-11 manometer incorporates a water reservoir with a screw operated displacer to allow rapid adjustment of the datum level in the manometer. Any change in the level in one tube affects the level in all of the other tubes because they are connected to the common reservoir.

The manometer incorporates quick release connectors on the side for rapid connection to appropriate models and instruments.



Requirements

**Electronic Manometer Bank - C30-12**

C30

An electronic console incorporating 16 differential pressure sensors each with a range of 0-178 mm H<sub>2</sub>O. The electrical supply for the manometer is obtained from the outlet socket on the front of the IFD7.

A common tapping ensures that all of the differential pressure sensors are referenced to atmospheric pressure. Quick release connectors (7 x single and 1 x 10-way) allow for rapid connection to models and instruments.

The electronic manometer connects to the control PC using a second USB port on the PC, and the readings are fully integrated with the wind tunnel control software for ease of use.



Requirements

**Lift and Drag Balance - C30-13 (\*requirement)**

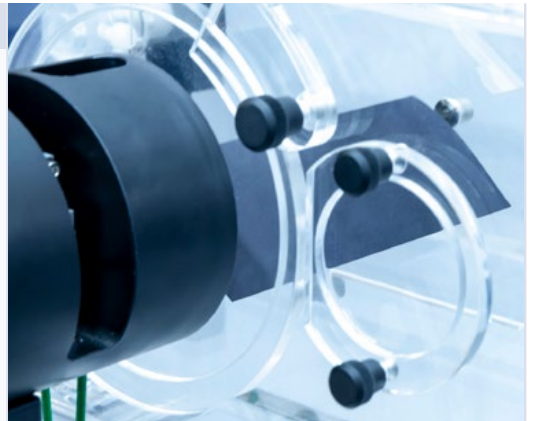
C30

C30-20  
or  
C30-22

A two-component balance which measures the lift and drag forces on models mounted within the C30 wind tunnel. The balance mechanism enables test models to be mounted and held securely in position in the working section of the wind tunnel.

The incorporated hex support arm transmits the forces on the test model directly to the integrated load cells. The lift and drag balance can be manually adjusted through pitch angles of  $\pm 45^\circ$ .

\*requires essential accessory C30-20 or C30-22)



Requirements

**Pitot Static Tube - C30-14**

C30

C30-20  
or  
C30-22

A miniature Pitot Static Tube mounted in a support plug that can be located in the roof of the working section at three alternative positions, i.e. the start of the working section and upstream and downstream of the model mounting position. The support plug incorporates an 'O' ring to retain the Pitot Tube where it is positioned and allows the tube to traverse over the full height of the working section to measure the velocity profile inside the working section of the tunnel.

The overall diameter of the Pitot Static Tube is 4 mm to give a stiff assembly without unduly disturbing the airflow downstream and the 'L' shaped arrangement, with the tip pointing into the flow, gives minimal disturbance at the point of measurement.

The two flexible tubes from the Pitot Static Tube incorporate a quick release connector that allows it to be connected to one of the optional manometers.

The Pitot Static tube is of Prandtl design and may be used with a negligible correction up to angles of yaw of at least 5 degrees.





**Wake Survey Rake - C30-15** (requires C30-11 or C30-12)

The rake consists of 10 stainless steel tubes positioned vertically in a row and pointing towards the airflow. The rake is mounted downstream of the model being used via the small access hatch in the side wall of the working section. The tubes are mounted at a fixed pitch of 11mm and are connected via flexible tubing to a multi-way quick release connector to suit the C30-11 or C30-12 manometers.

The rake is designed so that when mounted as described, the centre of the rake is aligned with the centre point or zero-angle centreline of models mounted through the large hatch. It will therefore cross the wake downstream of the model, allowing the pressure changes across the wake and therefore the changes in velocity to be measured.

When used with models such as the C30-21 Pressure Wing, readings can be taken from the pressure tappings on the model and the Wake Survey Rake without changing any settings by simply swapping the quick release connector on the appropriate manometer.

Requirements

C30  
C30-11  
or  
C30-12



**3-Component Balance - C30-16-Asoft**

A 3-component balance used to measure lift, drag and moment forces on appropriate models. The models connect to the balance using a simple fixing that ensures correct orientation of the model.

The system is designed to work with a series of Armfield models and also enables the user to manufacture and test their own 3D printed or fabricated wings to test and evaluate for project work.

Integrated electronic sensors are used to measure the lift, drag and moment forces. The model being tested can also be rotated on the mounting and the angle of rotation measured electronically.

The readings from the lift, drag, moment sensors and the rotation sensor are displayed on the control software screen running on the PC, and are available for data logging.

Requirements

C30



**3-Component Driven Balance - C30-17-Asoft** (\*requirement)

A PC controlled Driven 3-component balance incorporates a closed loop stepper drive for precise driven rotation angles particularly beneficial for remote operation/ remote learning activities and repetitious test and development.

\*requires essential accessory C30-19

Requirements

C30  
C30-19





Requirements

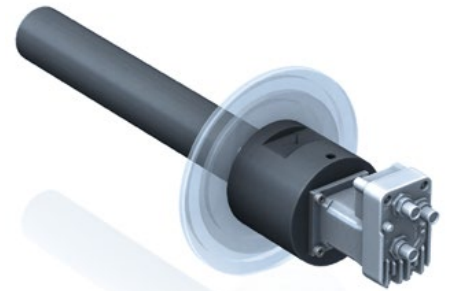
**Driven 360° Model Unit - C30-18** (requires C30-19)

C30

C30-19

A PC controlled driven 360-degree model interface with single pressure tapping take off to allow test models to be fitted with incorporated pressure tapping.

Suitable for use with C30-18-01 pressure cylinder or for users to manufacture and test their own 3D printed or fabricated samples to test and evaluate for project work. Particularly beneficial for remote operation/ remote learning activities and repetitious test and development.



Requirements

**Drag Models - C30-22** (requires C30-13)

C30

C30-13

Seven different models are provided for use with the C30-13 Lift and Drag Balance for investigations into the influence of shape on the drag forces.

Five models are supplied with a common equatorial diameter of 50mm, thus all presenting the same cross section to the airflow: Sphere - Hemisphere, convex to airflow - Hemisphere, concave to airflow - Circular disk - Streamlined shape. Additionally a dimpled golf ball and plain sphere demonstrate the difference in drag force due to the dimples.



Requirements

**Car Model - C30-35** (requires C30-44)

C30

C30-44

1:20th 3D printed scale model of a saloon car. It is easily mounted to the C30-44 Base Mount.

**Note: All models can be used in conjunction with the C-SMOKE Probe Smoke Generator to visualise airflow over the aircraft, car or wing models.**

**Airbus A320 Airplane Model - C30-36** (requires C30-43)

1:140th 3D printed scale model of an Airbus A320. It is easily mounted to the C30-43 Manual Model Mount through the rear of the aircraft and can be actuated  $\pm 45^\circ$ .

**Airbus A380 Airplane Model - C30-37** (requires C30-43)

1:140th 3D printed scale model of an Airbus A380. It is easily mounted to the C30-43 Manual Model Mount through the rear of the aircraft and can be actuated  $\pm 45^\circ$ .

**Boeing 737 Airplane Model - C30-38** (requires C30-43)

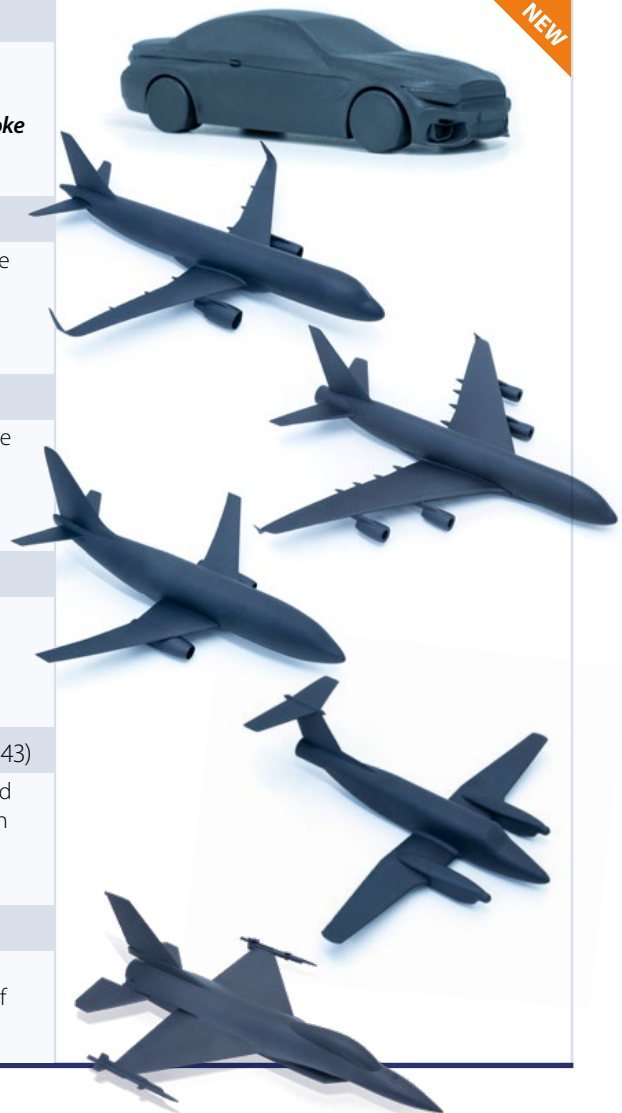
1:140th 3D printed scale model of a Boeing 737. It is easily mounted to the C30-43 Manual Model Mount through the rear of the aircraft and can be actuated  $\pm 45^\circ$ .

**Beech Bonanza A36 Airplane Model - C30-39** (requires C30-43)

1:140th 3D printed scale model of a Beech Bonanza A36. It is easily mounted to the C30-43 Manual Model Mount through the rear of the aircraft and can be actuated  $\pm 45^\circ$ .

**F-16 Airplane Model - C30-40** (requires C30-43)

1:140th 3D printed scale model of a General Dynamics F-16 Fighting Falcon. It is easily mounted to the C30-43 Manual Model Mount through the rear of the aircraft and can be actuated  $\pm 45^\circ$ .





**Wing Model - C30-30-01 to 04** (requires C30-13 or C30-16/17)

Wing model designed with a **Gottingen 535 Air foil** profile, as used on a slingsby T21b glider. The high camber profile is designed into an air foil to maximise its lift coefficient.

Wing model designed with a **NACA 633-618** profile, as used on the Schleicher Ka6b Glider. The profile is less cambered than the Gottingen 535 allowing direct comparison.

Wing model designed with a **NACA 64-212** profile, as used on the MDM-1 Fox aerobatic glider. The profile is almost symmetrical and cuts through the air evenly.

Wing model designed with a **Fauvel F2** as used on the FV-36 Flying Wing. The profile is a reflexed camber air foil where the camber line curves back up near the trailing edge. Such an air foil is useful in certain situations such as with tailless aircraft.

Requirements

- C30
- C30-13
- or
- C30-16 or C30-17



**Wing Model - C30-30-6** (requires C30-13 or C30-16/17)

Wing model designed with an asymmetric NACA 54118 profile.

(Requires C30-13 or C30-16/17)

Requirements

- C30
- C30-13
- or
- C30-16 or C30-17



**Wing Model - C30-30-7** (requires C30-13 or C30-16/17)

Wing model designed with a cambered NACA 4415 air foil profile, as used on a Murphy JDM-8 ultralight aircraft.

(Requires C30-13 or C30-16/17)



Requirements



**Aerofoil Model with Flap - C30-31** (requires C30-13 or C30-16/17)

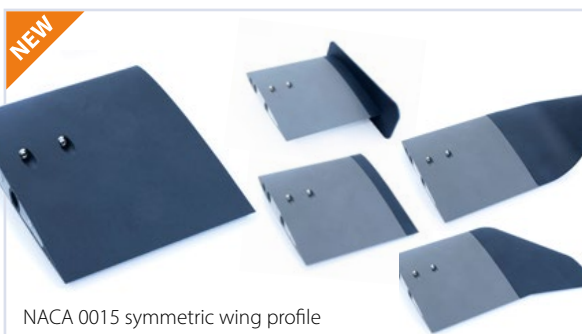
The aerofoil is a **NACA 2412** which has an symmetrical section with adjustable flap of  $\pm 90^\circ$ . This adjustable flap allows students to investigate the effects of control surfaces such as flaps, ailerons, elevator or rudder.

When used in conjunction with the C30-16/17 3-Component Balance, students can study the effects of lift, drag and pitch moment when adjusting this flap.

Adjustment of the flap is controlled manually through a hatch on the opposite side of the wind tunnel.

Requirements

- C30
- C30-13
- or
- C30-16 or C30-17



**Winglets Kit - C30-42** (requires C30-13 or C30-16/17)

Wingtip devices (or winglets) are intended to improve the efficiency of fixed-wing aircraft by reducing drag.

The winglets kit comes with **five different winglet profiles**:

Plain, Raked Winglet, Car Rear Spoiler, Wingtip Fence and Blended Winglet.

Each of these can be secured in turn, to the NACA 0015 symmetric wing profile and mounted to the C30-13 lift and drag or C30-16/17 three component balance.

Requirements

- C30
- C30-13
- or
- C30-16 or C30-17





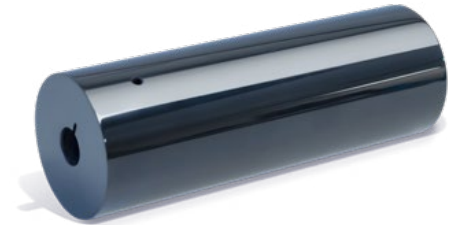
Requirements

**Cylinder With Pressure Tapping For 360° Drive - C30-18-01**

C30  
C30-19

Cylinder with single pressure tapping to interface with the driven 360-degree model unit enabling the study of pressure acting on a cylinder at various velocities and angular positions.

(Requires C30-19)



Requirements

**Pressure Wing NACA 0015 - C30-21** (requires C30-11 or C30-12)

C30  
C30-11  
or  
C30-12

A symmetrical NACA 0015 aerofoil incorporating 10 tapping points distributed around the wing profile that allow the pressure distribution to be measured from the leading edge to the trailing edge. The wing is mounted in the horizontal plane through the side of the working section, and the angle of attack is adjustable by rotating the circular hatch. Although only instrumented on one side, the effective pressure distribution on both surfaces can be obtained by inclining the aerofoil at positive and negative angles of attack.

The tapping points are all flush with the surface of the aerofoil and connected via flexible tubing to a multi-way quick release connector to suit the C30-11 or C30-12 manometers.

The NACA 0015 is one of a standard series of aerofoils. The 00 indicates that the two faces are symmetrical. The 15 indicates that the aerofoil has a 15% thickness to chord (width) ratio, (i.e. its thickness is 15% of its chord). This ratio is fairly typical for low-speed aerofoils, and possible applications include boat rudders as well as aircraft wings.



Requirements

**Pressure Cylinder - C30-23** (requires C30-20 or C30-22)

C30  
C30-20  
or  
C30-22

A plain cylinder, 30mm diameter, incorporating 10 equi-spaced pressure tappings around half of the circumference that allow the pressure distribution around the cylinder to be measured.

The cylinder is mounted in the horizontal plane through the side of the working section and can be rotated through 180° to plot the pressure distribution over the whole circumference.

The tapping points are all flush with the surface of the cylinder and connected via flexible tubing to a multi-way quick release connector to suit the C30-11 or C30-12 manometers.

(Requires C30-20 or C30-22)



Requirements

**Pressure Wing NACA 4415 - C30-33**

C30  
C30-11  
or  
C30-12

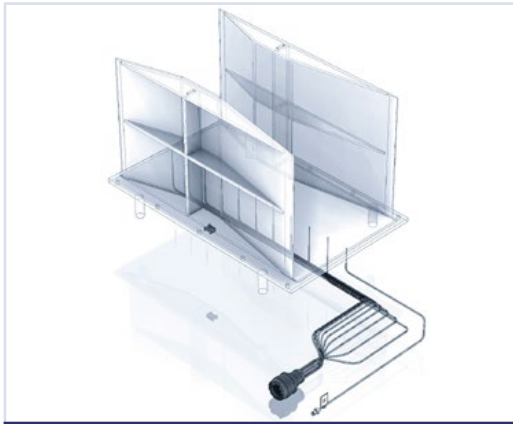
An asymmetric NACA 4415 aerofoil incorporating 16 tapping points distributed around the wing profile that allow the pressure distribution to be measured from the leading edge to the trailing edge.

The wing is mounted in the horizontal plane through the side of the working section, and the angle of attack is adjustable by rotating the circular hatch.

The tapping points are all flush with the surface of the aerofoil and connected via flexible tubing to a multi-way quick release connector and single quick release connectors to suit the C30-11 or C30-12 manometers.

(Requires C30-11 or C30-12)





**Bernoulli Apparatus - C30-24** (requires C30-20 or C30-22)

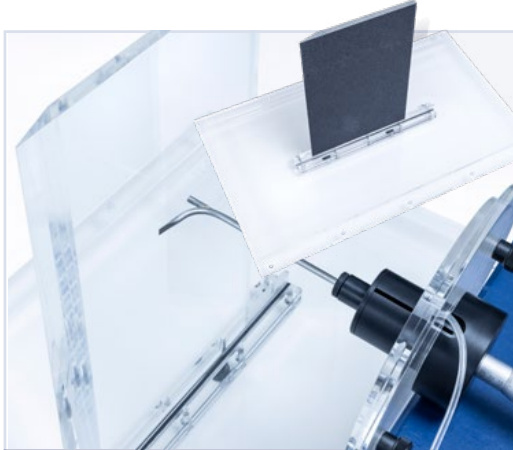
A Venturi profile that is installed in the working section of the tunnel via the removable floor. The Venturi incorporates 11 pressure tappings in the floor, connected via flexible tubing to quick release connectors to suit the C30-11 or C30-12 manometers.

The Venturi occupies the full height of the working section, and the width varies from full width at the inlet and outlet to 209mm at the throat. It is manufactured from clear acrylic for full visualisation.

By itself the C30-24 may be used to show the variation in static pressure with change in cross-section, but when used in conjunction with the Pitot Static Tube (C30-14) the Total Head and Static Head can also be measured at three locations allowing the local velocity to be measured and the Bernoulli equation to be fully demonstrated.

Requirements

C30  
C30-20  
or  
C30-22



**Boundary Layer Plate - C30-25** (requires C30-20 or C30-22)

A flat plate is mounted vertically in the working section via a removable floor panel incorporating a horizontal slot. A special flattened pitot tube mounted on a traversing micrometer allows the air velocity to be measured at different distances from the surface of the plate. The plate can be moved relative to the pitot tube to allow the velocity profile to be measured at any position between the leading edge and the trailing edge of the plate.

The special pitot tube (Total Head Tube) allows the average air velocity to be determined over a relatively small change in height by comparing the reading obtained with the static pressure reading in the working section.

A smooth plate and artificially roughened plate are included to show the difference between the development of laminar and turbulent boundary layers. The flexible tubing from the pitot tube incorporates a quick release connector to suit the C30-11 or C30-12 manometers.

Requirements

C30  
C30-20  
or  
C30-22



**Project Kit - C30-26** (requires C30-20 or C30-22)

The Project Kit provides a range of mountings suitable for models of the students' own design.

These mountings are made to fit the working section, so that students may concentrate on the design of the model itself. The kit also includes a selection of suitable flexible tubing for connecting tapping points to sensors, and connectors for use with the optional manometers.

Requirements

C30  
C30-20  
or  
C30-22



**Spring Mounted Wing Model - C30-34**

A symmetric aerofoil suspended on springs within a frame used to demonstrate the principle of wing flutter. Wing flutter is a dynamic instability of a flight vehicle associated with the interaction of aerodynamic, elastic and inertial forces.

The suspension positions of the wing, spring rate and centre of mass can be altered as well as the angle of attack  $\pm 10^\circ$ .

Requirements

C30





Requirements

**Driven 360 Degree Model Unit - C30-18** (requires C30-19)

C30

C30-19

A PC controlled driven 360-degree model interface with single pressure tapping take off to allow test models to be fitted with incorporated pressure tapping.

Suitable for use with C30-18-01 Cylinder With Pressure Tapping For 3600 Drive or for users to manufacture and test their own 3D printed or fabricated samples to test and evaluate for project work.

Particularly beneficial for remote operation/ remote learning activities and repetitious test and development.

(Requires C30-19)



Requirements

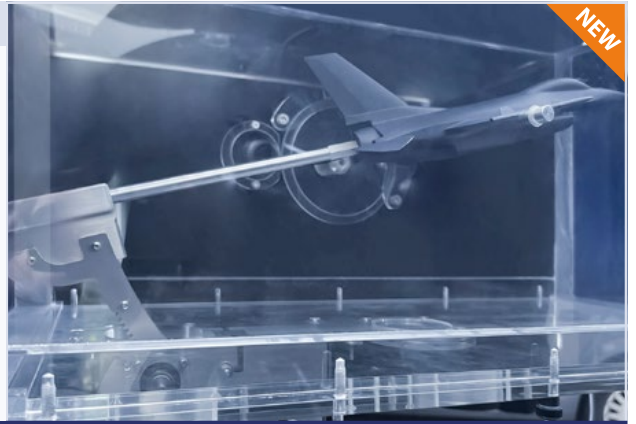
**Manual Model Mount - C30-43**

C30

The Manual Model Mount is to be used in conjunction with the airplane models to change the angle of attack of the aircraft whilst in operation.

The aircraft is secured onto the hex rod of the mount and rotates roughly around the centre of the aircraft wing.

The manual mount is capable of actuating  $\pm 35^\circ$  using the angle adjustment.



Requirements

**Base Mount - C30-44**

C30

A Base Mount used in conjunction with the C30-35 Car Model, also suitable for project work.



Requirements

**C-Smoke: Probe Smoke Generator**

C30

C15

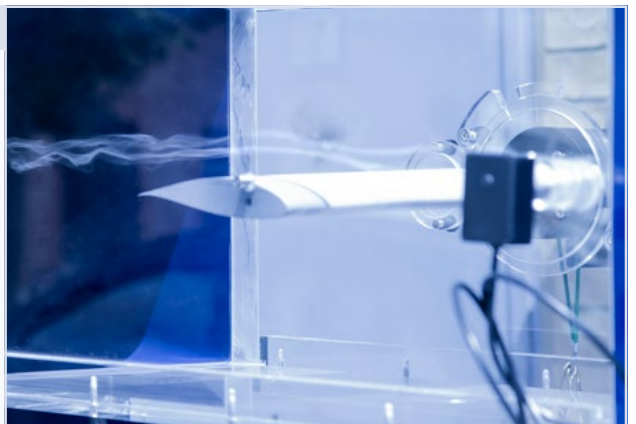
The C-Smoke smoke generator is designed to facilitate the observation of air movements and air tracing in wind tunnels.

With a rapid warm up time and simple to set up and use, it produces a controllable, non-hazardous smoke effect.

The system produces a point source of smoke on the end of a 425mm long stainless steel wand, commonly used when a very precise point source of aerosol smoke is required. The probe is shaped to minimise wake generation, ensuring that the smoke can be entrained into the airstream smoothly.

Supplied with:

- ▶ Control Box
- ▶ 2 x Vaporisers
- ▶ Swan Neck Probe - 425mm long
- ▶ 3 x 500ml Bottle of Oil



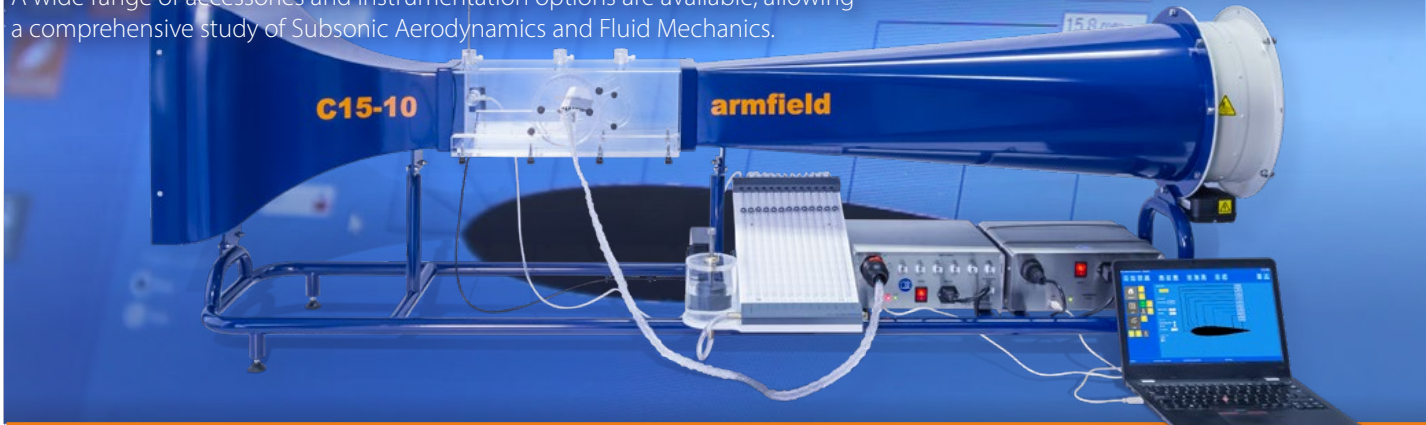


## C SERIES

# C15 – Computer Controlled Subsonic Wind Tunnel

A compact benchtop wind tunnel, with visible working section.

A wide range of accessories and instrumentation options are available, allowing a comprehensive study of Subsonic Aerodynamics and Fluid Mechanics.



Software Inc



### Computer Controlled Subsonic Wind Tunnel - C15

Requirements

The unit is a computer controlled subsonic bench-top wind tunnel designed for undergraduate teaching.

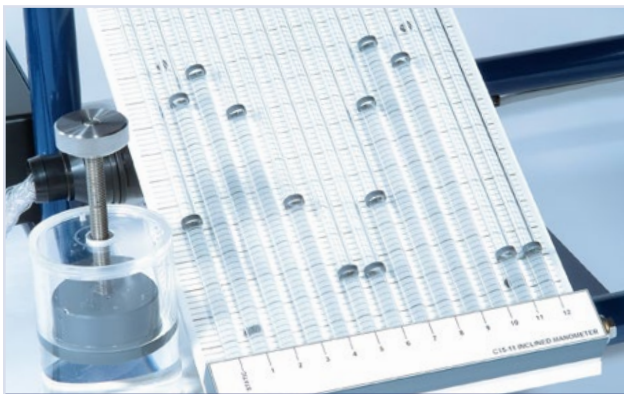
It has a 150mm (6 inch) transparent working section and offers a wide range of models for aerodynamic and air flow studies.

An extensive range of models, accessories & instrumentation is available for the C15.

PC

USB

1Ph



### Inclined Manometer Bank - C15-11

Requirements

A bank of 13 transparent tubes positioned vertically to measure small pressure differences (0 – 320 mm H<sub>2</sub>O) using water as the working fluid for safe operation and convenience in use.

The C15-11 manometer incorporates a water reservoir with a screw operated displacer to allow rapid adjustment of the datum level in the manometer. Any change in the level in one tube affects the level in all of the other tubes because they are connected to the common reservoir.

The manometer incorporates quick release connectors on the side for rapid connection to appropriate models and instruments.

C15



### Electronic Manometer Bank C15-12

Requirements

An electronic console incorporating 16 differential pressure sensors each with a range of 0-178 mm H<sub>2</sub>O. The electrical supply for the manometer is obtained from the outlet socket on the front of the IFD7.

A common tapping ensures that all of the differential pressure sensors are referenced to atmospheric pressure. Quick release connectors (7 x single and 1 x 10-way) allow for rapid connection to models and instruments.

The electronic manometer connects to the control PC using a second USB port on the PC, and the readings are fully integrated with the wind tunnel control software for ease of use.

C15





Requirements

**Lift and Drag Balance - C15-13** (\*requirement)

C15

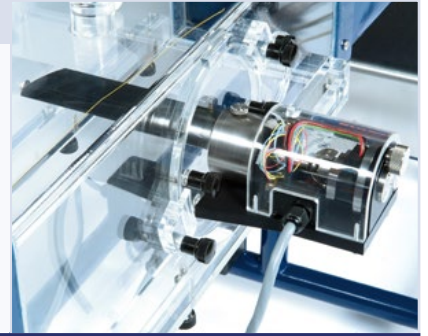
C15-20  
or  
C15-22

A 2-component, electronic balance used to measure the lift and drag on appropriate models. The lift and drag models connect to the balance using a simple fixing that ensures correct orientation of the model.

Electronic sensors are used to measure the lift and drag forces, the drag being measured directly, and the lift by a reduction in the model weight. The model being tested can also be rotated on the mounting and the angle of rotation measured electronically.

The readings from the lift and drag sensors and the rotation sensor are displayed on the control software screen running on the PC, and are available for data logging.

\*requires essential accessory C15-20 or C15-22



Requirements

**Pitot Static Tube - C15-14** (requires C15-11 or C15-12)

C15

C15-11  
or  
C15-12

A miniature Pitot Static Tube mounted in a support plug that can be located in the roof of the working section at three alternative positions (i.e. the start of the working section and upstream and downstream of the model mounting position). The support plug incorporates an 'O' ring to retain the Pitot Tube where it is positioned and allows the tube to traverse over the full height of the working section to measure the velocity profile inside the working section of the tunnel.

The overall diameter of the Pitot Static Tube is 4 mm to give a stiff assembly without unduly disturbing the airflow downstream and the 'L-shaped' arrangement, with the tip pointing into the flow, gives minimal disturbance at the point of measurement.

The two flexible tubes from the Pitot Static Tube incorporate a quick release connector that allows it to be connected to one of the optional manometers.

The Pitot Static tube is of Prandtl design and may be used with a negligible correction up to angles of yaw of at least 5 degrees.



Requirements

**Wake Survey Rake - C15-15** (requires C15-11 or C15-12)

C15

C15-11  
or  
C15-12

The rake consists of 10 tubes positioned vertically in a row and pointing towards the airflow. The rake is mounted downstream of the model being used.

The tubes are mounted at a fixed pitch of 5mm but the assembly can be displaced 2.5mm allowing measurements at intervals of 2.5mm by interlacing two sets of readings.

The tubes are connected via flexible tubing to a multi-way quick release connector.



Requirements

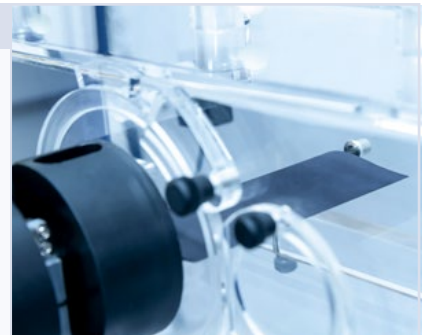
**3-Component Balance - C15-16-Asoft**

C15

A 3-component balance used to measure lift, drag and moment forces on appropriate models. The models connect to the balance using a simple fixing that ensures correct orientation of the model. The system is designed to work with a series of Armfield models and also enables the user to manufacture and test their own 3D printed or fabricated wings to test and evaluate for project work.

Integrated electronic sensors are used to measure the lift, drag and moment forces. The model being tested can also be rotated on the mounting and the angle of rotation measured electronically.

The readings from the lift, drag, moment sensors and the rotation sensor are displayed on the control software screen running on the PC, and are available for data logging.



Requirements

**3-Component Driven Balance - C15-17-Asoft** (\*requirement)

C15

C15-19

A PC controlled Driven 3-component balance incorporates a closed loop stepper drive for precise driven rotation angles particularly beneficial for remote operation/ remote learning activities and repetitious test and development.

\*requires essential accessory C15-19





**Driven 360° Balance - C15-18-Asoft** (\*requirement)

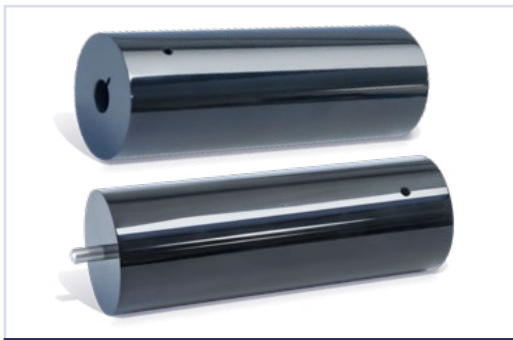
A PC controlled driven 360-degree model interface with single pressure tapping take off to allow test models to be fitted with incorporated pressure tapping. Suitable for use with C1518-01 pressure cylinder or for users to manufacture and test their own 3D printed or fabricated samples to test and evaluate for project work. particularly beneficial for remote operation/ remote learning activities and repetitious test and development.

\*requires essential accessory C15-19

Requirements

C15

C15-19



**Cylinder with Pressure Tapping for 360° drive - C15-18-01**

Cylinder with single pressure tapping to interface with the driven 360-degree model unit enabling the study of pressure acting on a cylinder at various velocities and angular positions.

Requirements

C15

C15-19



**Lift & Drag Aerofoil - C15-20** (requires C15-13)

A plain symmetrical aerofoil to NACA 0015 profile, incorporating a mounting rod that allows it to be installed on the C15-13 Lift & Drag Balance, thus allowing the lift and drag to be measured with the aerofoil at different angles of attack.

Requirements

C15

C15-11  
or  
C15-12



**Pressure Wing- C15-21** (requires C15-11 or C15-12)

A symmetrical aerofoil incorporating 10 tapping points distributed along the wing profile on one side, which allows the pressure distribution to be measured from the leading edge to the trailing edge.

The pressure distribution on the upper and lower surface can be obtained by inclining the aerofoil at positive and negative angles of attack. Machined to NACA 0015 profile, the aerofoil has the same section as the C15-20 to allow direct comparison of pressure distribution with the lift characteristics.

Requirements

C15

C15-11  
or  
C15-12



**Drag Models - C15-22** (requires C15-13)

Seven different models are provided for use with the C15-13 Lift and Drag Balance for investigations into the influence of shape on the drag forces.

Five models are supplied with a common equatorial diameter of 50mm, thus all presenting the same cross section to the airflow: Sphere - Hemisphere, convex to airflow - Hemisphere, concave to airflow - Circular disk - Streamlined shape. Additionally a dimpled golf ball and plain sphere demonstrate the difference in drag force due to the dimples.

Requirements

C15

C15-13





Requirements

**Pressure Cylinder - C15-23** (requires C15-11 or C15-12)

C15  
C15-11  
or  
C15-12

A plain cylinder, 30mm diameter, incorporating 10 equi-spaced tapping points around half of the circumference that allow the pressure distribution around the cylinder to be measured.

The cylinder can be rotated through 180° to plot the pressure distribution over the whole circumference.

\*requires essential accessory C15-11 or C15-12



Requirements

**Bernoulli Apparatus - C15-24** (requires C15-11 or C15-12)

C15  
C15-11  
or  
C15-12

A Venturi profile that is installed in the working section of the tunnel via the removable floor. The Venturi incorporates 11 pressure tapings in the floor, connected via flexible tubing to quick release connectors.

The Venturi occupies the full height of the working section and the width varies from 150mm (full width of the working section) at the inlet and outlet to 100mm at the throat. It is manufactured from clear acrylic for full visualisation.

\*requires essential accessory C15-11 or C15-12



Requirements

**Bernoulli Apparatus - C15-24** (requires C15-11 or C15-12)

C15  
C15-11  
or  
C15-12

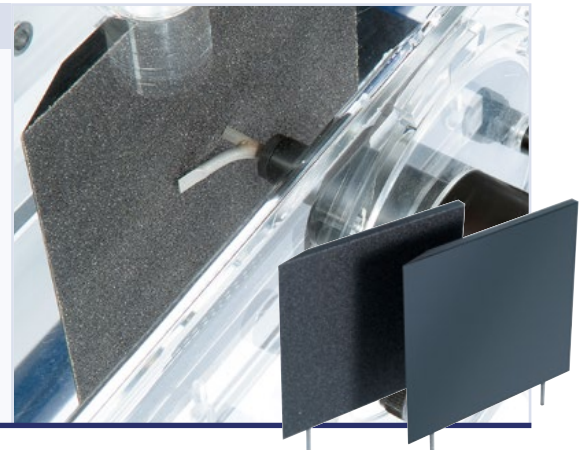
A flat plate, with a bevelled leading edge, that is mounted vertically in the working section via the removable floor. A flattened Pitot tube, mounted on a traversing micrometer, allows the air velocity to be measured at different distances from the surface of the plate.

A smooth plate and artificially roughened plate (above) are included to show the difference between laminar and turbulent boundary layers. The flexible tubing from the Pitot tube incorporates a quick release connector.

**C15-26: Project Kit**

A selection of components that allow alternative models to be constructed by the user. Includes a floor panel, a circular hatch and a set of connectors with appropriate flexible tubing.

\*requires essential accessory C15-11 or C15-12



Requirements

**C-Smoke: Probe Smoke Generator**

C15  
C30

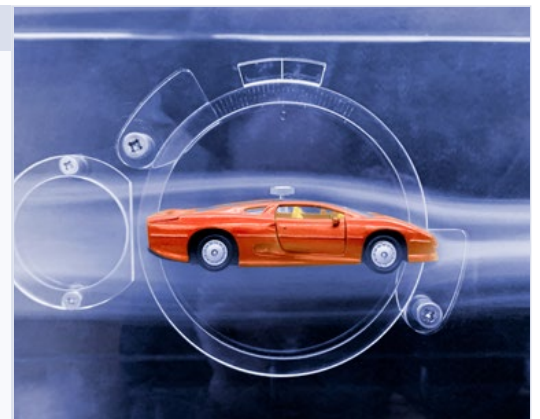
The C-Smoke smoke generator is designed to facilitate the observation of air movements and air tracing in wind tunnels.

With a rapid warm up time and simple to set up and use, it produces a controllable, non-hazardous smoke effect.

The system produces a point source of smoke on the end of a 425mm long stainless steel wand, commonly used when a very precise point source of aerosol smoke is required. The probe is shaped to minimise wake generation, ensuring that the smoke can be entrained into the airstream smoothly.

**Supplied with:**

- ▶ Control Box
- ▶ 2 x Vaporisers
- ▶ Swan Neck Probe - 425mm long
- ▶ 3 x 500ml Bottle of Oil





# Fluid Machines



## Computer Controlled Fans, Compressors, Pumps and Turbines

The Armfield Fluid Machines range introduces students to a range of Desktop Computer-Controlled Turbo Machines covering Fans & Compressors, Pumps and Turbines.

*These highly visual products offer full computer control and data logging as standard.*

Non return valve operation



IFD7 - Essential accessory for FM range



### Propeller Turbine Demonstration Unit - FM63

A miniature-scale propeller turbine unit, which is supplied as a floor-standing unit complete with a sump tank and recirculating pump. The turbine is housed in clear acrylic pipe work permitting excellent visibility. The turbine is loaded by an electronically controlled brake fitted with a load cell to measure the torque.

#### Requirements

- 1Ph
- IFD 7



Software inc



Requirements

IFD  
7

**Turbine Service Unit - FM6X**

A bench mounted unit consisting of a clear acrylic reservoir and a variable speed centrifugal pump, which provides water to power the accessory on test. The service unit also incorporates a water flow meter and electrically controlled dynamometer, which puts a load on to the turbine and measures the torque and speed.

*FM6X Turbine Service Unit shown with FM62 Pelton Turbine Demonstration Unit.*

**Pump Test Accessory - FM64**

The FM64 is a compact accessory, which allows the FM6X service unit to be used as a pump test accessory.

Software  
inc



Requirements

FM  
6X

**Axial Flow Impulse Turbine - FM60**

A miniature-scale axial flow, impulse turbine consisting of a brass runner, which is acted on by four jets of water.

The flow to the turbine can be adjusted by changing the pump speed or closing off any of the nozzles.

The turbine is housed in clear acrylic for excellent visibility.

The unit is designed to mount on the FM6X Turbine Service Unit.

Software  
inc



Requirements

FM  
6X

**Radial Flow Reaction Turbine - FM61**

A miniature-scale radial flow reaction turbine, where water enters through a face seal and exits tangentially through two orifices. The reaction of these jets causes rotation of the runner.

The turbine is housed in clear acrylic for excellent visibility.

The unit is designed to mount on the FM6X Service Unit.

Software  
inc



Requirements

FM  
6X

**Pelton Turbine - FM62**

A miniature-scale Pelton wheel turbine, complete with a spear valve to control the water flow. The turbine buckets are shaped to extract maximum momentum from the passing jet of water, while the spear valve is designed to enable adjustment of the cross sectional area of the jet.

The turbine is housed in clear acrylic for excellent visibility.

The unit is designed to mount on the FM6X Service Unit.

Software  
inc





### Centrifugal Fan Demonstration Unit - FM40

The centrifugal fan is a radial flow machine, which produces the necessary pressure to move gas by the centrifugal force built up inside the fan casing. The design of the fan blade has a primary influence on performance.

These types of fans are usually employed for ventilating duties requiring a somewhat higher delivery pressure than that available from axial fans.

Requirements

IFD  
7



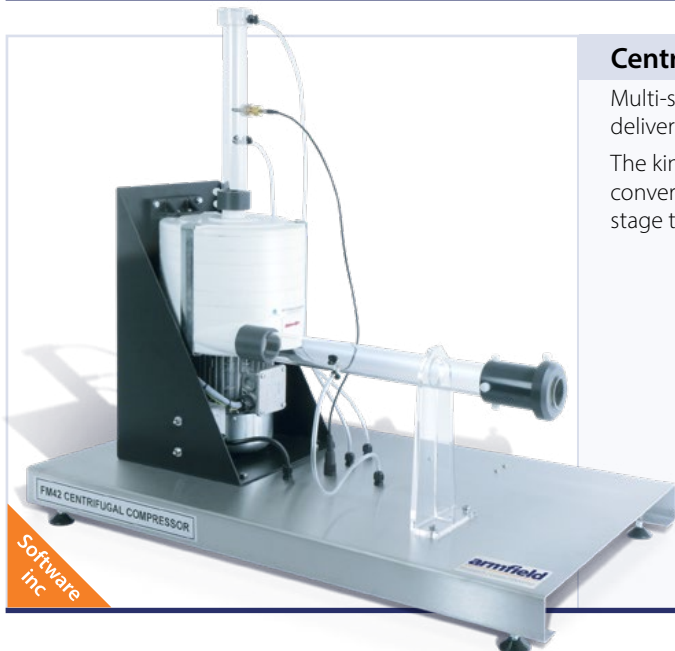
### Axial Fan Demonstration Unit - FM41

The axial fan produces gas flow by virtue of the momentum changes imparted across the rotary blades, parallel to the axis of rotation. Such fans are more suitable for higher flows at lower delivery pressures than their centrifugal counterparts.

Comparison of the performance characteristics of the FM41 Axial Fan with those of the FM40 Centrifugal Fan thus provides an instructional exercise of valuable practical application.

Requirements

IFD  
7



### Centrifugal Compressor Demonstration Unit - FM42

Multi-stage compressors are used industrially for high pressure deliveries of gas flows or suction duties.

The kinetic energy imparted to the gas by the impeller rotation is converted into pressure energy, which progressively increases from stage to stage.

Requirements

IFD  
7





Requirements

## Centrifugal Pump Demonstration Unit - FM50

IFD  
7

The centrifugal pump is the machine most commonly used to move liquids from one place to another. As such it's a particularly instructive unit, which introduces students to the whole subject of rotodynamic fluid machines.

Discovering the relationship between head, flow, rotational speed and power provides a framework of general applicability.

For example, matching the required duty point to the conditions of maximum energy efficiency may be explored as a creative student project.



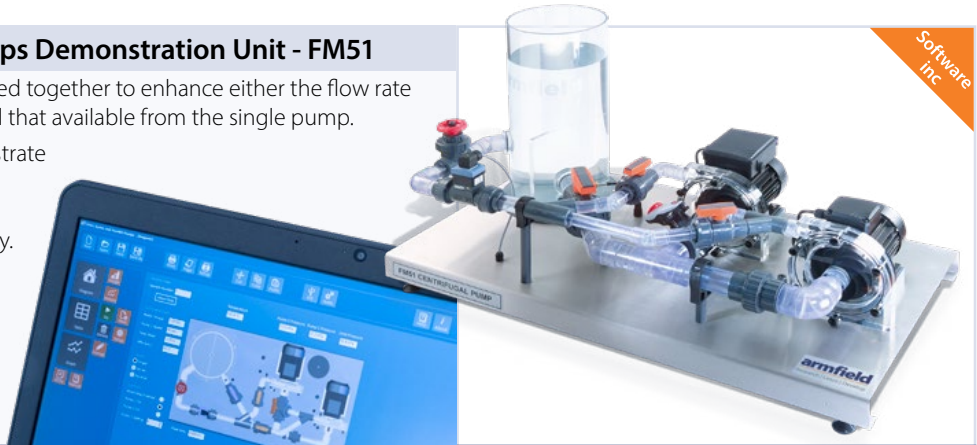
Requirements

## Series and Parallel Pumps Demonstration Unit - FM51

IFD  
7

Centrifugal pumps are often used together to enhance either the flow rate or the delivery pressure beyond that available from the single pump.

The unit is designed to demonstrate the operational advantages of parallel or series operation, depending on the required duty.



Requirements

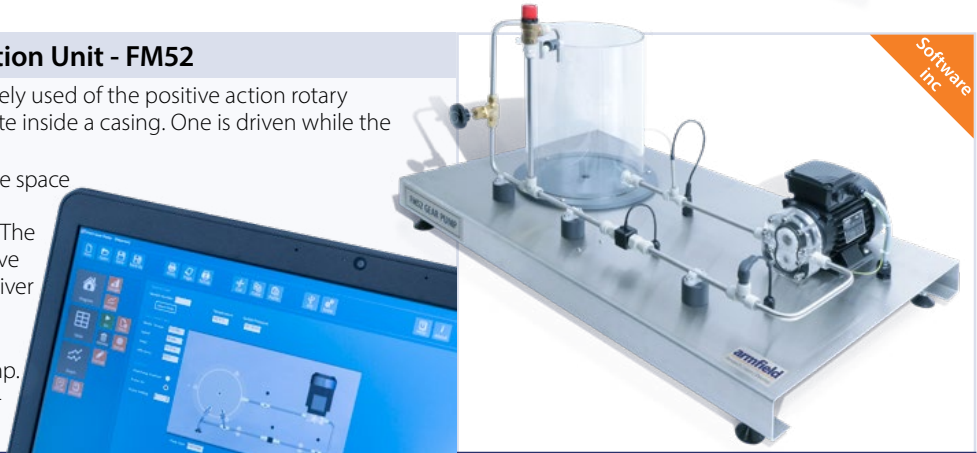
## Gear Pump Demonstration Unit - FM52

IFD  
7

The gear pump is the most widely used of the positive action rotary pumps. Two gear wheels operate inside a casing. One is driven while the other rotates in mesh with it.

The liquid is carried around in the space between consecutive teeth and then ejected as the teeth mesh. The pump has no valves. It is a positive displacement pump and will deliver against high pressures.

The output is a more even flow than that of a reciprocating pump. It is particularly suitable for high-viscosity fluids.



Requirements

## Plunger Pump Demonstration Unit - FM53

IFD  
7

The plunger or ram pump is a positive displacement pump and is used for pumping small quantities of liquid at high pressures. It is similar to a piston pump except that the sealing gland is at one end of the cylinder.

The reciprocating motion of the plunger gives an uneven flow, although the inclusion of a damping vessel can reduce this effect.

**\*Priming is unnecessary.**



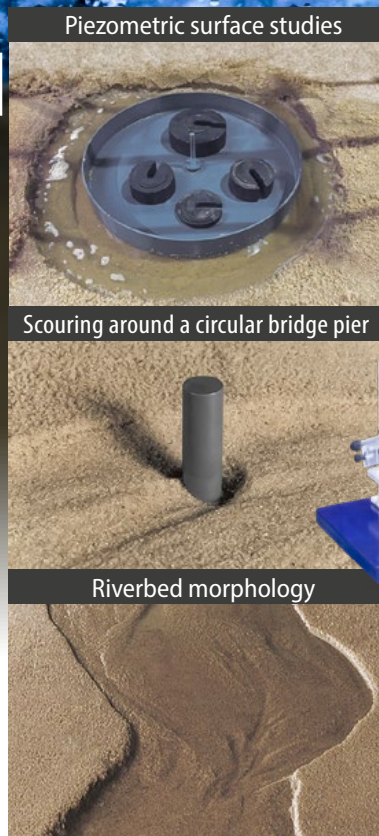
**S**  
SERIES

# Hydraulics & Hydrology

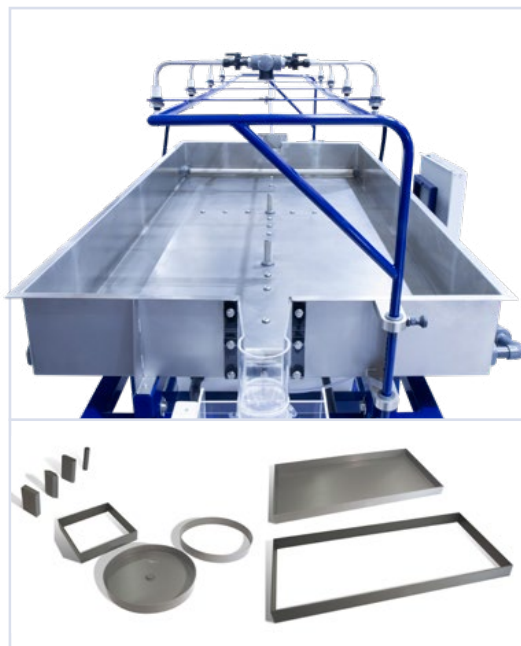


## Rainfall, Drainage, Sediment Flow and Erosion

This range of products offers both laboratory and field-learning opportunities. It also introduces such diverse topics as crop water requirements, erosion, soil moisture content, ground water flow, plant water need and sprinkler irrigation systems.



Environmental Hydrology System - S12-MKII



### Environmental Hydrology System - S12-MKII Advanced Environmental Hydrology System - S12-MKII-50

This floor-standing Hydrology System includes features suitable for studying fluvial geomorphology. It combines the capabilities of the Rainfall Hydrographs and Ground Water Flow Unit into a single comprehensive facility. The system is fully instrumented for investigation of rainfall/run-off hydrographs, ground water abstraction studies and unique to this apparatus, fluvial mechanics.

Data logging accessory available.

#### S12-Models for use with S12-MKII

A set of models available as an option to facilitate the various experiments listed in the teaching manual, it includes:

- **Fabricated trays and rings:**
  - Closed ring with removable central clear plastic standpipe
  - Circular open-ended ring
  - Small square open-ended ring
  - Large rectangular open-ended ring
  - Large rectangular closed ring with hole
- **Impermeable catchment**
- **Permeable catchment**
- **Model structures machined from solid PVC:**
  - Cylinder
  - Rectangular bridge pier
  - Rounded bridge pier
  - Streamlined bridge pier

#### Requirements

- 1Ph
- PC
- USB
- COLD





## Sediment Erosion Flume – S28

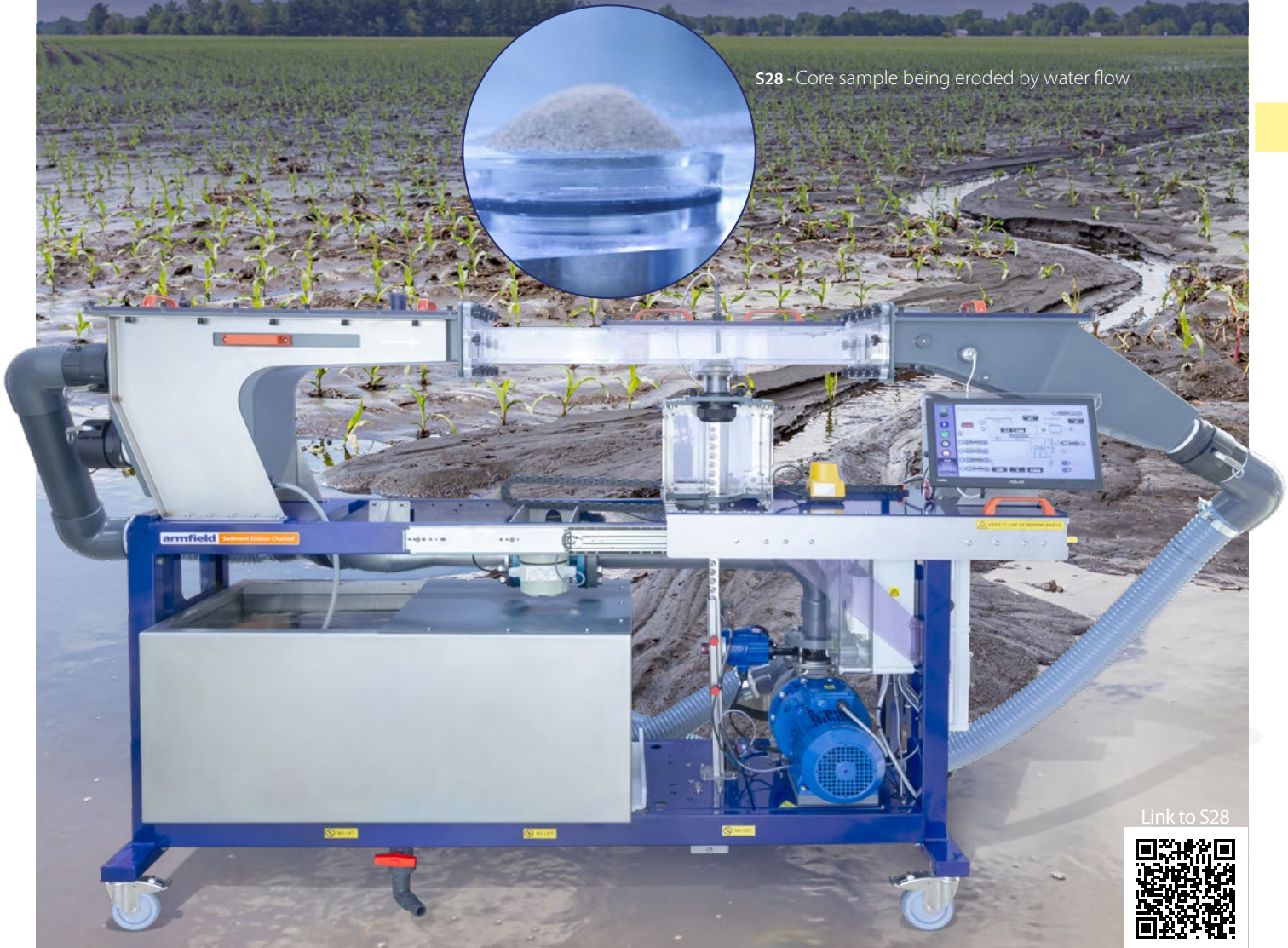
Armfield S28 Sediment Erosion Flume is a multipurpose research tool developed to enable investigations into the erosion, transportation and sedimentation of cohesive particles in piped networks and natural systems.

The recirculation-style flume uses a set of interchangeable channel sections that allow a broad range of experimental capabilities.

Test medium can be in the form of core samples, general soil or vegetation samples.

The flume has been developed to generate variable flow across a range of shear stresses, fully automated and precisely incremented to accurately determine erosion thresholds for poorly consolidated sediment (e.g. silty mud) through to consolidated heavy clay-like soils.

S28 - Core sample being eroded by water flow



Link to S28



### Requirements



### Sediment Erosion Flume – S28

A multi purpose, automated mobile research platform designed to facilitate the study of sediments and erosion, test medium can be in the form of core samples, general soil or vegetation samples.

#### Options, models and instruments available:

- ▶ Sediment Core Module (150 x 75mm Section) (supplied as standard)
- ▶ Wide Erosion Studies Module (300 x 100mm Section) + Bridge Insert (option)
- ▶ Narrow Erosion Studies Module (150 x 50mm Section) + Bridge Insert (option)
- ▶ Sediment Core Module (105 x 50mm Section) (option)



Software inc

## Applied Hydraulics & Hydrology - S Series



### Drainage and Seepage Tank - S1

This self-contained facility is designed to enable a comprehensive study of flow through permeable media. Using sand and the various two dimensional models supplied, it is possible to determine flow lines, seepage rates and the distribution of uplift pressures.

A useful facility for student project work in engineering hydrology.

- ▶ Flow line visualisation
- ▶ Flow net construction
- ▶ Determining seepage rates
- ▶ Verification of Darcy's Law
- ▶ Comparison of experimental results with analytical solutions

#### Requirements



### Rainfall Hydrographs - S10

The unit is a compact unit for the study of a variety of rainfall run off situations. A range of accessories enables the effects on the flood hydrograph of surface reservoir retention, depression, storage effects and land drainage to be demonstrated.

#### Requirements



### Ground Water Flow Unit - S11

A bench standing sand tank capable of demonstrating hydrological principles of ground water flow and the applications of these to certain water resource engineering constructions.

Demonstrations of flood risks associated with land drainage works, the use of wells for both water abstraction, de-watering and the drainage of lakes and polders are all readily performed.

The unit enables simple three-dimensional flow situations to be set up quickly and measurements of piezometric levels taken at appropriate positions within the model.

#### Requirements



### River Flow Simulator - S17

The Armfield River Flow Simulation tank demonstrates river feature formation, including flow and bed load motion.

It provides an excellent introduction to the study of fluvial geomorphology and can also demonstrate sophisticated and advanced concepts for research purposes.

#### Requirements





## Requirements

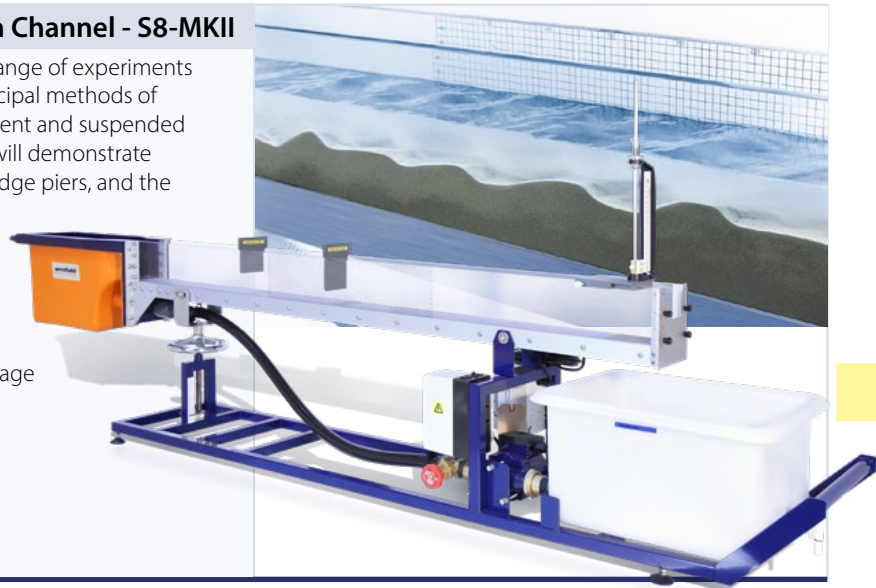


### Sediment Transport Demonstration Channel - S8-MKII

This apparatus has been designed to allow a range of experiments to be performed to demonstrate the two principal methods of sediment transport in water: bed load movement and suspended sediment transport. In addition, experiments will demonstrate local scour at channel obstructions such as bridge piers, and the secondary flow in channel beds.

#### Experimental content includes:

- ▶ Regimes of Fixed-Bed Flow
- ▶ Initiation of Bedload Motion
- ▶ Bedforms in Sand
- ▶ Hysteresis of Bedforms during Changing Stage
- ▶ Scour at Structures
- ▶ Sediment Transport Rate
- ▶ Flow Resistance in a Gravel Bed



## Requirements



### Mobile Bed and Flow Visualisation Tank - S2

A versatile apparatus for teaching, project and research work. Available with 2.0m or 4.0m long working section.

#### The tank may be used in two principal fields of study:

- ▶ Hydraulic modelling of mobile bed situations such as water courses or civil engineering structures
- ▶ Two-dimensional flow visualisation using, for example, the Ahlborn dust indicator technique

#### Experimental content includes:

- ▶ Two-dimensional Flow Patterns
- ▶ Three-dimensional Flow Patterns
- ▶ Hydraulic Model Studies
- ▶ Unsteady Flow Patterns
- ▶ Loose Boundary Demonstrations



## Requirements



### Hydraulic Flow Demonstrator - S16

A free-standing accessory to the F1-10 Hydraulic Bench that enables hydraulic phenomena, associated with the flow of water through both open channels and close conduits, to be set up quickly, easily and visually demonstrated. Measurements taken in each configuration permit the associated flow conditions to be analysed.

An elevating section of the bed inside the channel and models of various hydraulic structures enable the difficult concepts of critical flow/velocity/depth and energy changes to be clearly demonstrated and analysed.

Models supplied include the Undershot Weir, Overshot Weir, Narrow crested Weir, Broad crested Weir, Ogee Weir and Culvert. In all cases, the effects of changes in upstream and downstream water level can be investigated.

Also available:

**Hydraulic Flow Demonstrator - S16-11** (Direct Reading Flowmeter)



## H SERIES

# Hydrology Instrumentation



Armfield offer a range of instrumentation and measuring devices, these include gauges, manometers, pitot tubes, probes and laser PIV



### Vernier Hook and Point Gauge

Requirements

The measurement of steady state water surface position is frequently needed during hydraulic investigations. This is done by using a small point or hook manually adjusted to touch the water surface, and a reading is taken of the vertical movement using a scale or vernier.

- H1-1** 150mm Scale Vernier Hook and Point Gauge
- H1-2** 300mm Scale Vernier Hook and Point Gauge
- H1-3** 450mm Scale Vernier Hook and Point Gauge
- H1-7** 300mm Scale Digital Hook and Point Gauge
- H1-8** 500mm Scale Digital Hook and Point Gauge
- H1-11** Adjustable Tripod Stand with Mountings



### Series Liquid Manometers

Requirements

A range of general purpose laboratory manometers using liquid displacement to measure differential pressure.

- H12-1** 1m Scale Open Water Manometer
- H12-2** 1m Scale Pressurised Water Manometer
- H12-5** 500mm Scale Kerosene-Water Manometer
- H12-6** Free Standing Support Column
- H12-7** Pressure Tapping System
- H12-8** Basic Portable Pressure Meter
- H12-9** Portable Pressure Meter - 140mBar



### Pitot Tubes

Requirements

A range of Pitot tubes for the measurement of water velocity in open channels and closed ducts.

- H30-1H** 150mm Pitot Tube
- H30-2H** 300mm Pitot Tube
- H30-3H** 450mm Pitot Tube

H12





Requirements

## Propeller Velocity Flowmeter

Used to measure and record very low point velocities in water and other conductive fluids, the H33 uses the change in impedance of a rotating multi-bladed impeller to indicate rotational speed caused by the flowing fluid.

- H33-1** 0.025-1.5 m/s Velocity Probe
- H33-2** 0.6-3 m/s Velocity Probe
- H33-3** (+90 degree head), 0.025-2.5 m/s Velocity Probe
- H33-10** Digital Indicator c/w 3m cable
- H33-DTA-ALITE** Data Logger



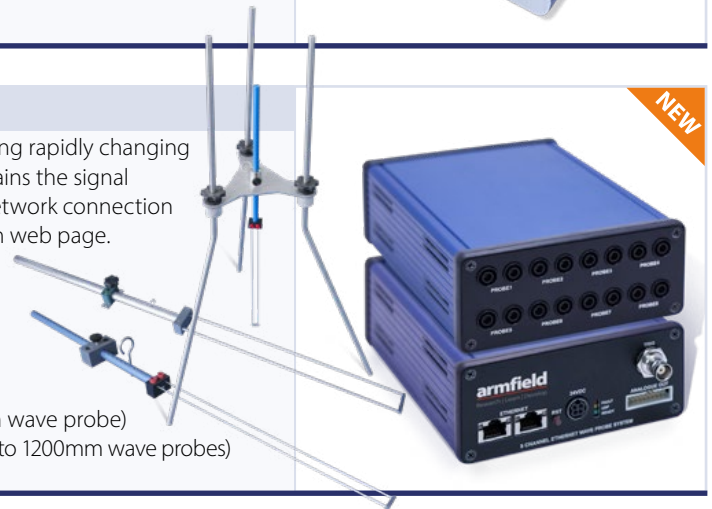
Requirements

1Ph

## Wave Probe System

The wave gauge is a simple and reliable device for measuring rapidly changing water levels in physical models. The wave probe case contains the signal conditioning circuitry for up to eight wave probes and a network connection to allow a computer to configure the probes via the built-in web page.

- H40-MKII** Wave Probe Case 8 Channels
- H40-MKII-1** Twin Wire Wave Probe 300mm
- H40-MKII-2** Twin Wire Wave Probe 600mm
- H40-MKII-3** Twin Wire Wave Probe 900mm
- H40-MKII-4** Twin Wire Wave Probe 1200mm
- H40-MKII-6** Twin Wire wave Probe stand (for 300mm wave probe)
- H40-MKII-7** Twin Wire wave Probe Tripod (for 600mm to 1200mm wave probes)



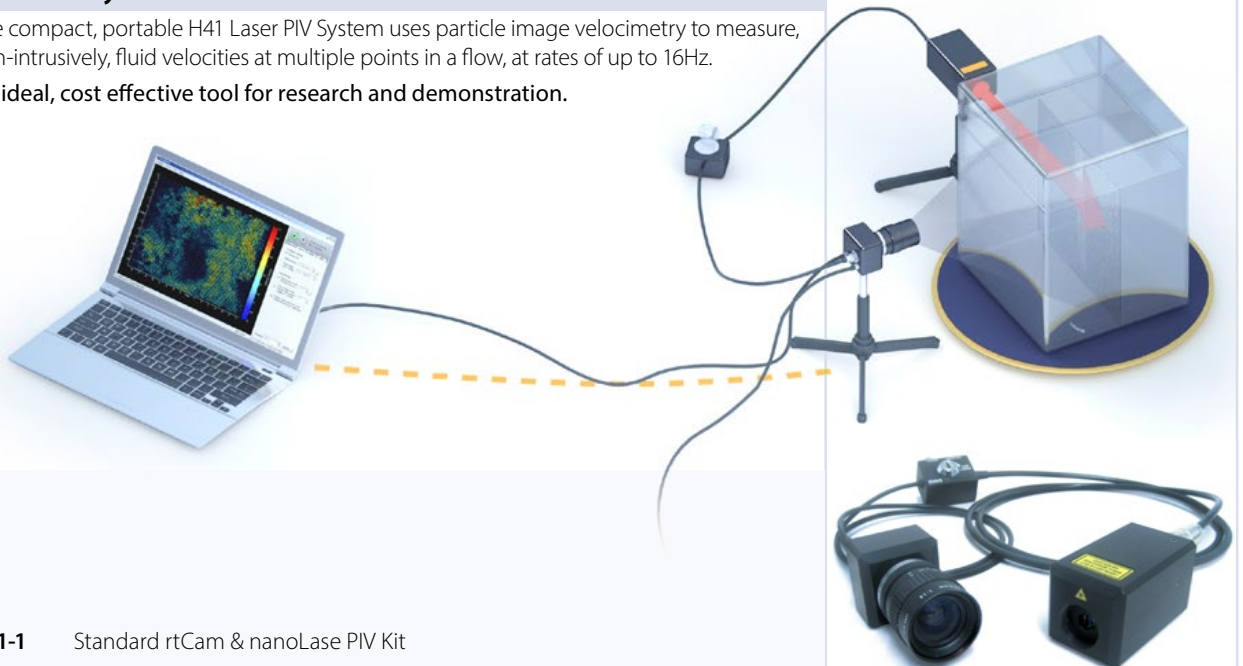
Requirements

PC  
USB

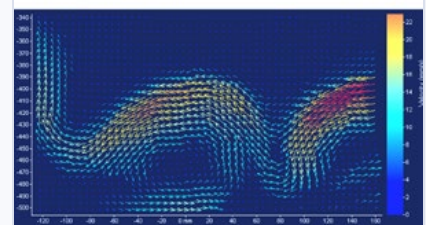
## Laser PIV System

The compact, portable H41 Laser PIV System uses particle image velocimetry to measure, non-intrusively, fluid velocities at multiple points in a flow, at rates of up to 16Hz.

An ideal, cost effective tool for research and demonstration.



- H41-1** Standard rtCam & nanoLase PIV Kit
- H41-2** Standard rtCam & submersible nanoLase PIV Kit
- H41-3** 20 degree Light Sheet Optic for nanoLase
- H41-4** 200g of Water Suitable Seeding Particles
- H41-5** 1.5m Tripod for the rtCam
- H41-6** Snakearm with Magnetic Base for nanoLase
- H41-7** Snakearm with G-Clamp Base for nanoLase



# Standard Teaching Flume S6-MKIII

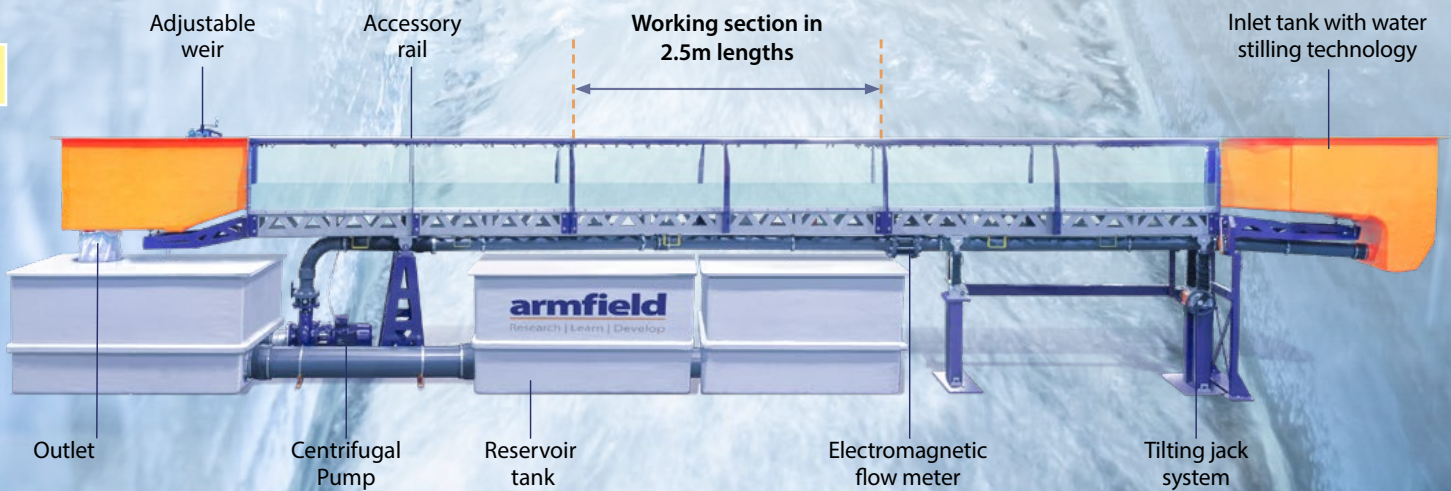


The Armfield S6-MKIII laboratory flow channel is one of the most important tools available to the hydraulics or civil engineer, whether engaged in teaching basic principles or researching solutions to practical problems. Many applications in fluid mechanics are associated with the flow of water through an open channel where the water has a free surface that is exposed to the air at atmospheric pressure.

The flumes are available in different lengths from 5 to 17.5m in 2.5m sections and examples are installed in educational and research establishments throughout the world.

A comprehensive range of accessories, and measuring instruments are available including discharge control, wave generation and a closed loop for sediment transport studies.

## S6-MKIII - Teaching and research flume



### Standard Teaching and Research Flume – S6-MKIII

Requirements

0.3m wide x 0.45m deep x 2.5m section.  
Flumes are available from 5 to 17.5m in 2.5m increments.

#### Options, models and instruments available:

- ▶ Tilting up to 17.5 meters
- ▶ Sediment transport options
- ▶ Manual or electric jacking
- ▶ Software Control and Data Acquisition Package option
- ▶ Data Logging & Instrumentation Package option
- ▶ Multiple model options available
- ▶ Walkway option
- ▶ Window options

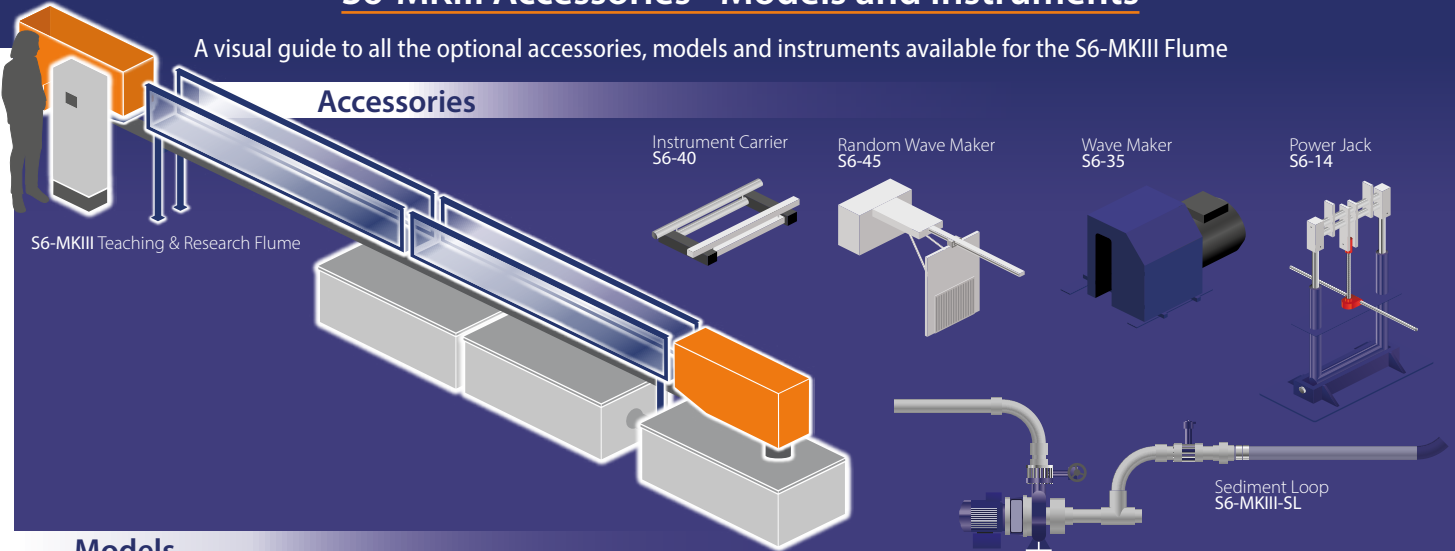




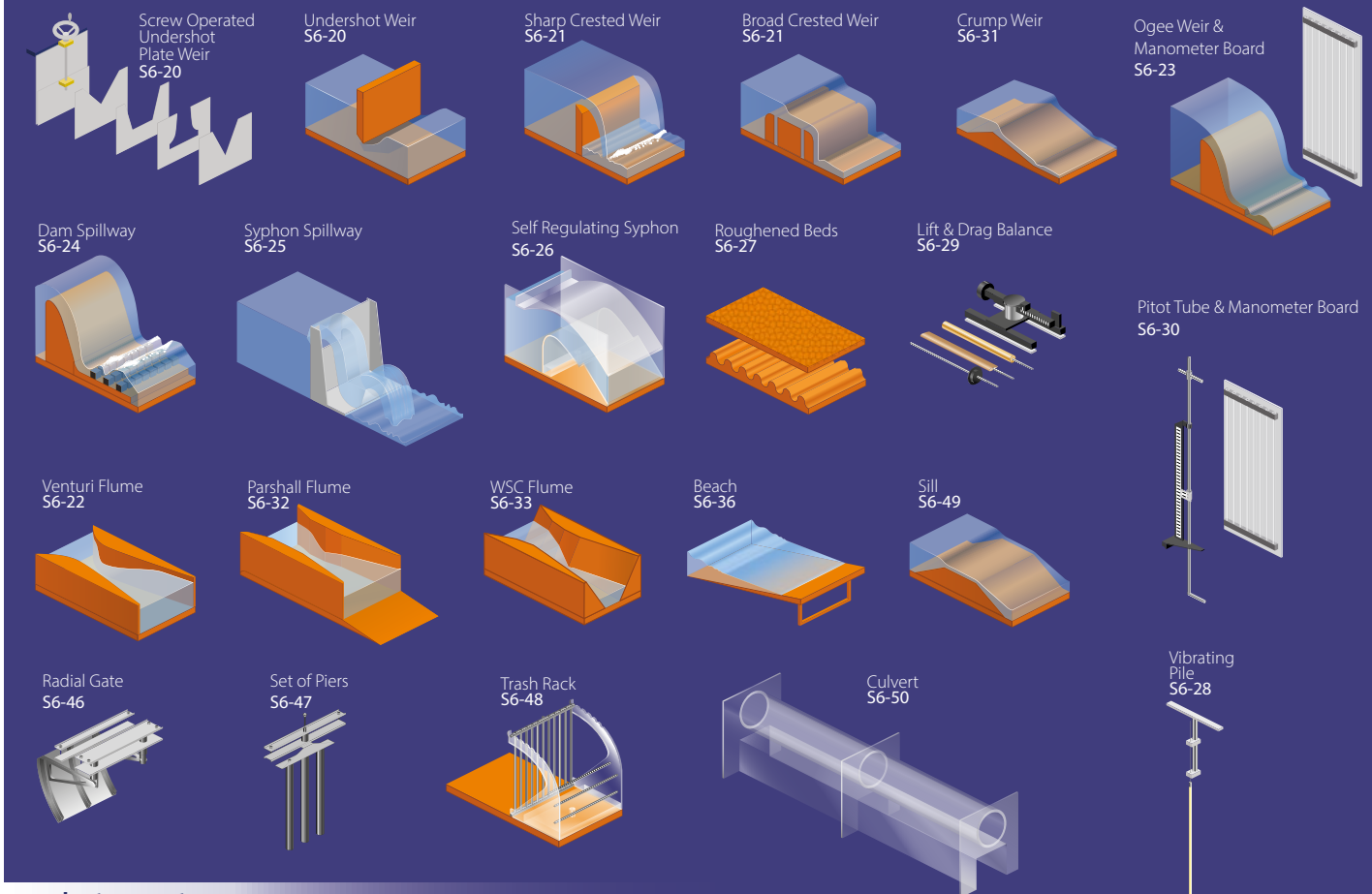
# S6-MKIII Accessories - Models and Instruments

A visual guide to all the optional accessories, models and instruments available for the S6-MKIII Flume

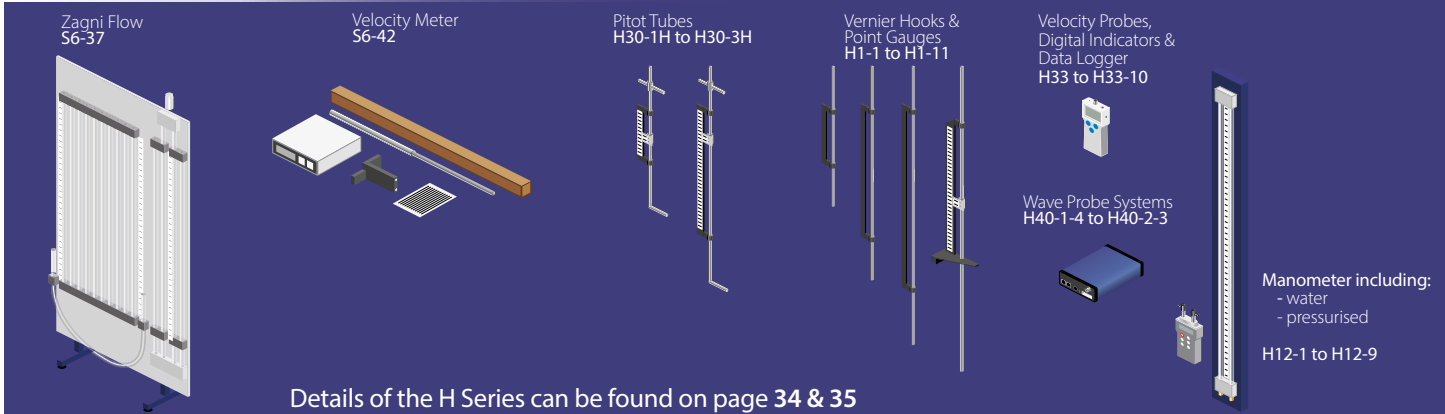
## Accessories



## Models



## Instruments





# Research Flumes



## The world-leading fixed bed and tilting flume technology supplier for over 50 years

Representing innovative product evolution, Armfield's latest series of fully configurable, modular flume systems are designed to exceed the requirements of research and teaching facilities alike.

Available as free discharge, recirculation or a combination of both; flumes systems are accompanied by a range of Hydraulic & Hydrology equipment that includes tanks, basins, experimentation models and instrumentation.

- ▶ **Standard research flumes** (available as tilting or fixed bed and in several working lengths)
- ▶ **Standard computer controlled research flumes** (available as tilting or fixed bed and in several working lengths)
- ▶ **Special flumes, tanks and basins**
- ▶ **Ancillary equipment:**
  - Sediment transport facilities
  - Mono and random wave makers
  - Instrumentation
  - Wind simulation

The **S80** wind over wave research flume built to simulate environmental effects



Pictured here is an **S60** static bed research flume, modular and cost effective with extremely high water flow rate



Example of a **S100** tilting bed research flume, engineered for minimum deflection in an easily shipped modular design



**Bespoke system design for your application available from Armfield**

**As with all of our equipment, we can install, commission and offer full training and on site maintenance.**

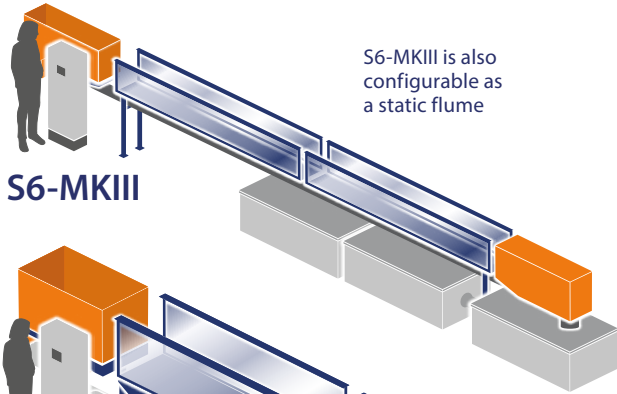
Channels can be designed to incorporate the following features (depending on customer requirements):

- ▶ Fixed bed or variable slope
- ▶ Self-contained or laboratory supplied water
- ▶ Open circuit or re-circulating sediment load
- ▶ Choice of working section materials (glass, metal, wood)
- ▶ Wind and wave generators
- ▶ Instrumentation systems for flow, velocity, level, etc.
- ▶ Sediment sampling and weighing
- ▶ Extremely high flow rates possible

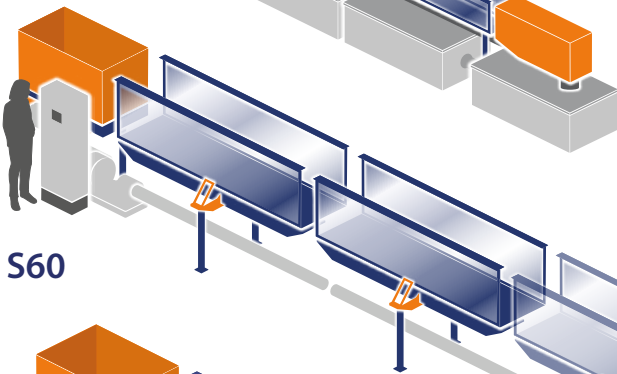
## Modular Standard Fixed Bed and Standard Tilting Bed Flumes

Armfield flumes are engineered with the industry's most comprehensive range of options:

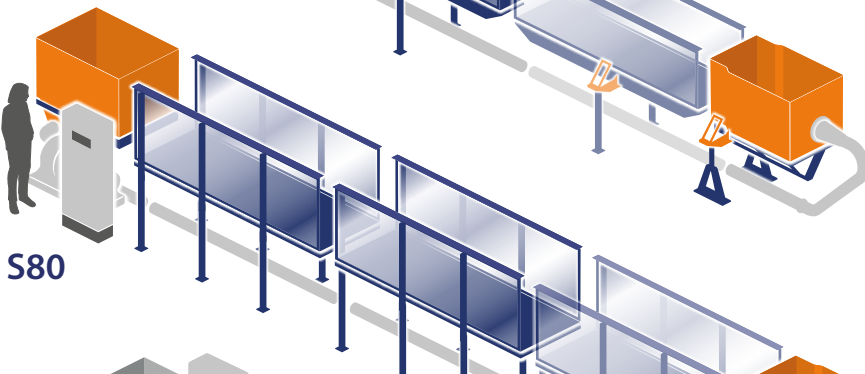
- ▶ Control and acquisition
- ▶ Sediment transport / feeding / weighing / extraction
- ▶ Random and mono wave generation systems
- ▶ Walkways, gantries and jacking systems
- ▶ Bespoke pumping solutions from single to multiple pumps with flow rates ranging from 1-1000 l/sec
- ▶ Weir types including: venetian weir; base hinge; stop log; gate & sluice
- ▶ Integrated touchscreen PLC control and logging systems
- ▶ Optional glass base sections for full particle image velocimetry (PIV) analysis
- ▶ Standard Lengths from 5m- 50m
- ▶ Models & Instrumentation



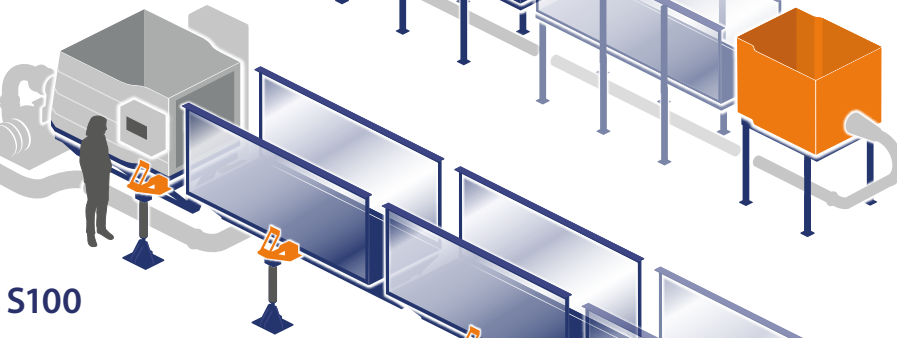
S6-MKIII



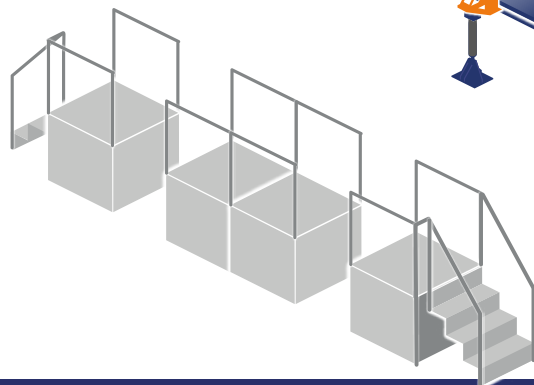
S60



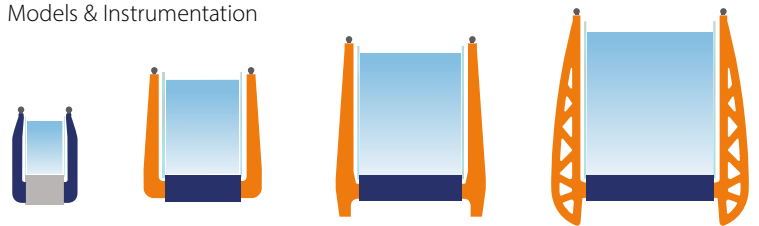
S80



S100



Modular walkway, tank & gantry systems for all flumes in our range



Flume range cross section

### Configurable modular flumes

#### Working section dimensions

Flume	Type	Width	Depth	Length (in 2.5m increments)
S6-MKIII	Tilting	0.3m	0.45m	From 5m-17.5m
S60ST	Static	0.6m	0.8m	From 5m-50m+
S60	Tilting	0.6m	0.8m	From 5m-30m
S80ST	Static	0.8m	1.0m	From 5m-50m+
S80	Tilting	0.8m	1.0m	From 5m-30m
S100ST	Static	1.0m	1.2m	From 5m-50m+
S100	Tilting	1.0m	1.2m	From 5m-30m

Standard size flumes, available in free discharge or recirculation. Bespoke lengths and widths can also be offered.

\*Note: length of tilting flume subject to tilt requirements

Flumes can be built to length in multiples of 2.5m working sections (add end & feed tanks, plus pumps and any other outboard ancillaries to obtain overall flume length and width)



Requirements

**Standard Teaching and Research Flume – S60** PLC control included 0.6m wide x 0.8m deep x 2.5m sections

- 3Ph
- PC
- USB
- COLD

Options, models and instruments:

- ▶ Free discharge or recirculation configurations
- ▶ Sediment transport options
- ▶ Tilting up to 30 meters
- ▶ Static bed up to 50 meters
- ▶ Weir options available



Tilting bed shown

Requirements

**Standard Teaching and Research Flume – S80** PLC control included 0.80m wide x 1.0m deep x 2.5m sections

- 3Ph
- PC
- USB
- COLD

Options, models and instruments:

- ▶ Tilting up to 30 meters
- ▶ Static bed up to 50 meters
- ▶ Sediment transport options
- ▶ Weir options available
- ▶ Free discharge or recirculation configurations



Static bed shown

Requirements

**Standard Teaching and Research Flume – S100** PLC control included 1.0m wide x 1.2m deep x 2.5m sections

- 3Ph
- PC
- USB
- COLD

Options, models and instruments:

- ▶ Free discharge or recirculation configurations
- ▶ Sediment transport options
- ▶ Tilting up to 30 meters
- ▶ Static bed up to 50 meters
- ▶ Weir options available



Tilting bed shown



# Research Flume Options & Solutions



## Wind Generation / Wave Generation / Sediment Transport / Electrical Jacking / Reservoir Tanks

Armfield offer numerous options for incorporation into our range of large Flumes (S60, S80, S100). Many of these options can be combined together to offer greater flexibility for simulation and research.



### PLC Flume Computer Control

All Armfield large scale research flumes are supplied with a floor standing control panel. The cabinet houses the frequency inverters which control the tilt and pump motor speeds. As standard the Armfield flume is supplied with a PLC control system with HMI touch screen interface.

The system can be run in manual mode enabling the user to operate flow, depth, infeed, tilt etc, (depending on options).

When the system is set in automatic mode the desired water depth, incline and flow rate can be selected, the system will then monitor the settings and using PID control data maintain the desired output (depending on options).



### Wind Simulation

An optional Integrated computer operated wind simulation system can be provided, offering mono or bi-direction wind.

The wind simulation is provided with a variable speed fan system connected to a clear cowling running over the flume.

Variable wind simulation speeds up to and more than 25 m/s are available.



### Wavemaking

Armfield offers multiple wave generator options from simple paddle systems, through to multi-paddle computer-controlled wave generating systems.

For many applications, particularly coastal models and flume studies, long crested and directional random waves are sufficient to model the sea state. For offshore studies and some shallow water problems multi-directional components are required.

Flumes may be used to study breakwaters, sea walls and beach behaviour or for fundamental research.



### Flood Gate

Flood event research with a computer controlled release system, this option will open up environmental experimentation.

Our engineers have designed an option to carry out flood event studies, leaky barriers, dam research, effect on structures and more. This flume furthers our involvement in creating equipment for environmental erosion studies.

Braided river, accumulations of logs and flood sediment studied in an Armfield research flume



Research being conducted into macro algae at the total environment simulator built by Armfield for the University of Hull

## Sediment Transfer

Armfield can offer options for running sediment transfer experimentation within the flumes.

**Dedicated transfer** – A separate solids handling pump is installed and connected to the drop out section. The pump can be used with sedimentation up to 10mm in size, which is then pumped to the start of the working section for redistribution. This system can be operated continuously.

**Sediment transfer through the main circulation pump** – This is particularly suitable for experimentation of fine suspended sediment. The pumps are lined and are designed to handle sedimentation up to 4mm in size. The suspended sediment is pumped through the main pipework and this system can be operated continuously.

**Sediment collection and extraction** – Where sediment needs to be collected and not automatically recirculated a series of valves are fitted to the drop out section enabling periodic extraction of deposited sediment.



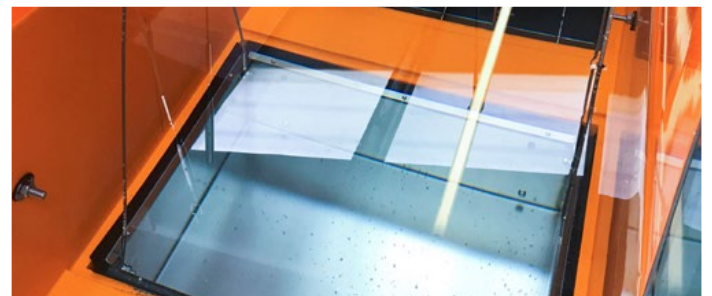
## Sediment Weighing

Armfield offer a dedicated sediment weighing facility.

The system catches mobile bed sediment in conjunction with an expansion point and removable diverter plate to drop out suspended sediment.

The mass of the captured sediment is measured and shown on the main control console this is then recorded on the data logging system.

*Note: the weigh system needs to be removed if operating sediment transport option*



## Reservoir Tanks

Storage/reservoir tanks can be offered along with walkways mounted above to give access to the flume working section.

*The S6 flumes are supplied with reservoir tanks as standard.*

- ▶ Armfield can use existing header tanks or sumps
- ▶ Flumes can be supplied as a fully self-contained system



## Actuated Flume Tilt Control

This is available for S60, S80 and S100 flumes

- ▶ Tilting up to 30 meter working section
- ▶ Integrated control within our bespoke flume software
- ▶ Tilting flume configuration (maximum available tilt 5%)



River bed and bank studies into erosion via fish and crustacean activity



**W**  
SERIES

# Water Treatment

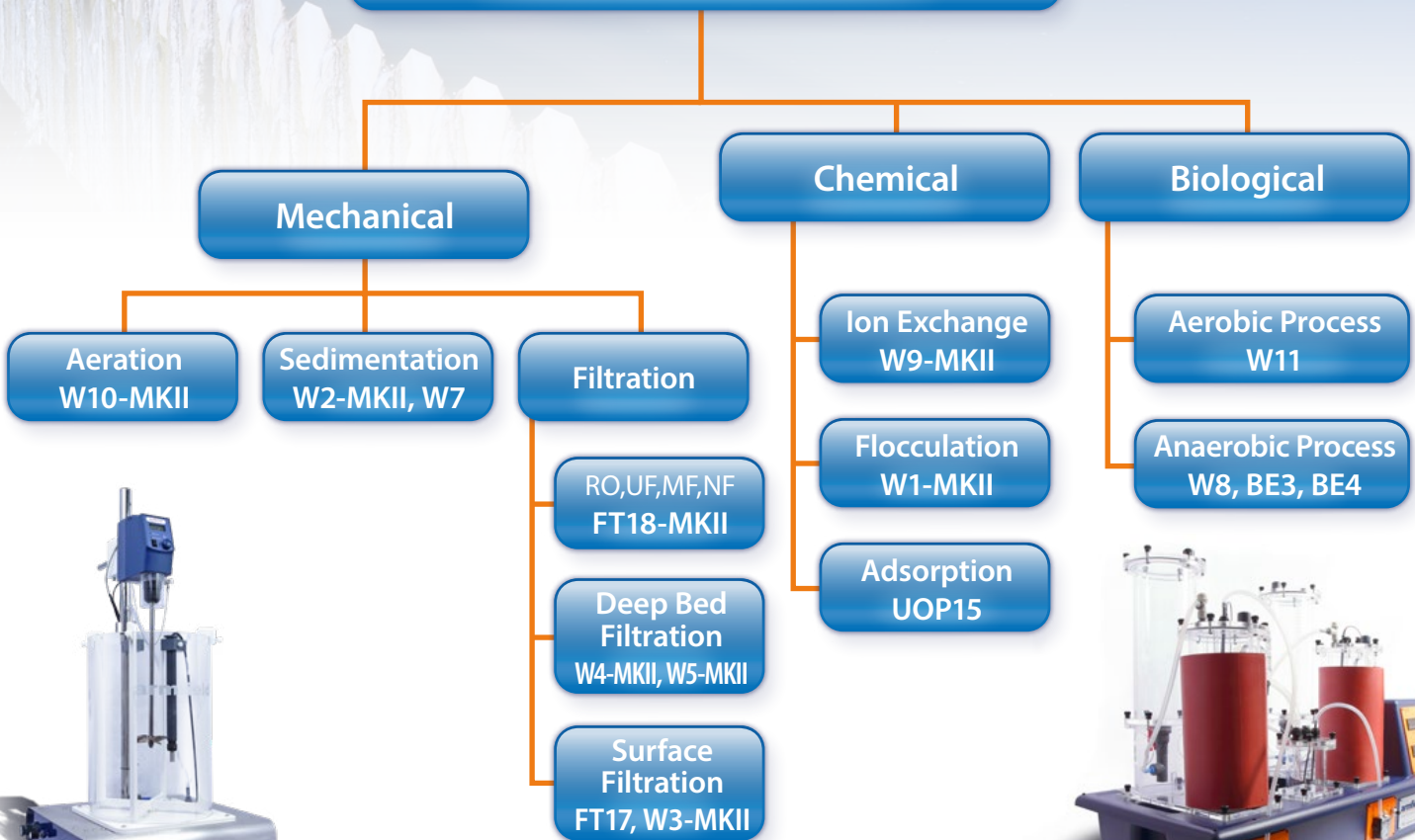


## Common processes covered by Armfield's Water Treatment range

- ▶ This range of simple yet comprehensive products covers the major elements of water treatment processes
- ▶ Several of the products can also be used industrially both for testing and experimentation



### Wastewater Treatment Process



W10-MKII Aeration Unit



W11 Aerobic Digester



Requirements

## Flocculation Test Unit - W1-MKII

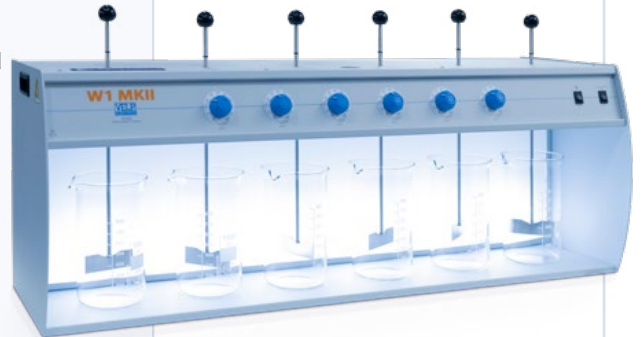
1Ph

Analysis of a water or waste preparatory to help in the design of a treatment sequence often involves coagulation and flocculation experiments in the laboratory. These tests, called jar tests, are widely used for control of plant operations and are routinely performed by treatment plant operators.

The coagulation and flocculation tests serve to indicate the optimum chemical dosages for removal of turbidity and colour, including such auxiliary facets as pH adjustment, and the necessity for the supplemental use of activated carbon.

The Flocculation test unit allows students to investigate the following:

- ▶ Determination of optimum coagulant dosage
- ▶ Determination of optimum pH
- ▶ Effect of mixing time and intensity



Requirements

## Sedimentation Studies Apparatus - W2-MKII

1Ph

The study of how particles settle in a liquid is of importance to many industries. The Armfield Sedimentation Studies Apparatus provides students with the opportunity of observing settling or sedimentation phenomena in a simple and readily identifiable manner. Students can measure settling rates as a function of particle size, density, and concentration in a static water system. From these results, batch settling curves may be deduced, which can then be used for the design of industrial settlers and thickeners. The equipment supplied also allows industrial tests to be made on any slurry system of interest. The equipment allows students to study the following topics:

- ▶ Effect of initial concentration on sedimentation characteristics
- ▶ Construction of the rate of settling curve against concentration from a single batch test
- ▶ Effect of initial height on sedimentation characteristics



Requirements

## Permeability/Fluidisation Studies Apparatus - W3-MKII – armBUS integrated

1Ph

PC

USB

This apparatus is designed for students to measure and understand the characteristics of flow through a bed of particles. Such flows occur naturally and in process plant designs.

It may also be used for a part of the testing of media for water and waste water treatment processes.



Software Inc



Requirements

## Filterability Index Unit - W4-MKII – armBUS integrated

1Ph

PC

USB

The unit enables a water treatment test to be made on a suspension to be filtered through sand or similar granular media.

Whilst developed as a teaching tool, it can also be used in routine control at waterworks, or at a sewage treatment works that employs tertiary filtration.



Software Inc



Software  
inc



## Deep Bed Filter Column - W5-MKII – armBUS integrated

This laboratory deep bed filter column has been designed to operate identically to full-scale granular filters.

Using the same bed depth and filter media, tests on this unit provide operational data, which may be scaled up to full size. Pilot trials of possible filter designs for water and sewage works can be made reliably at low cost.

### Requirements



## Model Sedimentation Tank - W7-MKII

This unit has been designed to demonstrate the hydraulic characteristics and settling efficiencies of a model settling basin.

Although scale-up to industrial size sedimentation tanks is difficult, relevant deductions can be made as to how non-uniform flows occur and how these interact with the settling characteristics of particular suspensions.

### Requirements



## Anaerobic Digester - W8

Anaerobic treatment processes involve bacteria, which function only in the absence of air.

This digester is designed as a bench top training facility and as a means of providing operational process data for plant design purposes.

### Requirements



Software  
inc

## Ion Exchange Unit - W9-MKII – armBUS integrated

A low cost, bench mounted unit designed to demonstrate the use of ion exchange resins for either continuous water softening or demineralisation.

The equipment is designed to emulate the industrial operation of such units, including monitoring breakthrough and regeneration cycles.

### Requirements





## Requirements

### Aeration Unit - W10-MKII – armBUS integrated

1Ph

PC

USB

The purpose of this aeration unit is to permit the study of the oxygen transfer characteristics of diffused air systems including the physical and chemical parameters that influence their oxygenation capacity.

These studies are a necessary prelude to the understanding of the biological treatment of waste waters.



## Requirements

### Aerobic Digester - W11

1Ph

The continuous activated sludge process has been successfully employed in public health engineering installations for nearly a century.

The bench top aerobic digester is a comprehensive study facility of this biological water treatment process - using a safe, synthetically prepared waste water.

**Chilled Water Circulation Unit - CW-17 (Option)**



## Requirements

### Cross Flow Membrane Filtration - FT17

1Ph

PC

USB

A lab-scale system for evaluating membranes in a cross flow filtration application enabling rapid determination of cross flow filtration performance using a range of membrane types with small product volumes (1 litre).

It can also be used in teaching applications to demonstrate features of different membrane types and the effect of varying filtration variables.



## Requirements

### Reverse Osmosis/Ultrafiltration Unit - FT18-MKII

3Ph

COLD

COMP.

AIR

A small pilot-scale cross-flow filtration system designed to operate with a range of membrane module configurations. It can be operated with as little as 5-10 litres of material to give data that is useful for process scale-up.

It can be used over the full range of cross-flow filtration applications from microfiltration through to reverse osmosis.

- ▶ Integral data logging of all parameters
- ▶ Capable of: **Microfiltration / Ultrafiltration / Nanofiltration & Reverse Osmosis**
- ▶ **Ceramic, Spiral Wound, Tubular and Hollow Fibre** membranes available



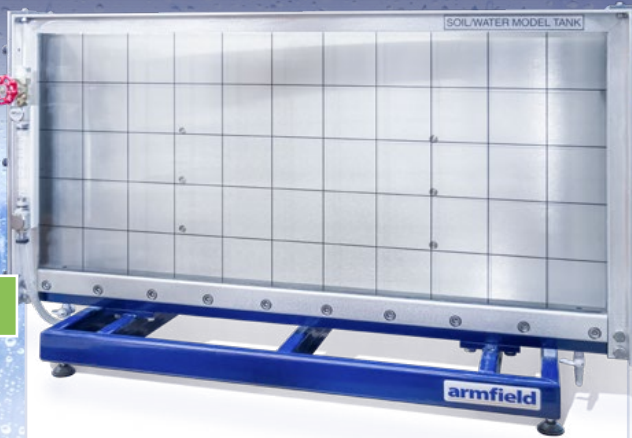


# Irrigation Water Management



The Armfield FEL Series – with continued population growth in parts of the world where growing crops is most challenging, irrigation is the obvious way to maximise the potential.

This range of products offers both laboratory and field-learning opportunities. It also introduces such diverse topics as gauging and control structures plus evapotranspiration.



### Soil/Water Model Tank - FEL2

The soil/water model tank has been developed to help students of irrigation understand more fully the interaction of factors which influence water movement both on the soil surface and in the soil profile.

The equipment allows actual surface irrigation experiments to be performed on a small scale in the laboratory.

#### Requirements



### Rainfall Simulator - FEL3

The Rainfall Simulator can also be used in the laboratory or in the field for a wide range of research from studies of infiltration under sprinkler irrigation to estimating soil loss in high intensity tropical storms.

Erodibility of soils can be studied in the laboratory and the influence of crop cover on the effect of rainfall can also be investigated.

It is ideal for investigating the relationship between rainfall and soil erosion, the nature of soil erosion potential on different soil types and identifying methods by which erosion may be prevented.

#### The simulator incorporates:

- ▶ Aperture adjustment
- ▶ Field and lab test plots
- ▶ Tilting stand
- ▶ Rain gauges

#### Requirements



### Soil Moisture Suction Sand Table - FEL4

Primarily for the derivation of soil moisture characteristic curves, the unit helps in understanding the principle of water retentivity and its relationship with soil moisture levels.

#### Demonstrate and understand:

- ▶ The principles of water retentivity in terms of soil suction
- ▶ Relationship between soil texture and soil water characteristics
- ▶ The relationship between water retentivity and soil
- ▶ Influence of soil structure on the soil water characteristics of a soil
- ▶ Derive soil moisture characteristic curves for a variety of soil
- ▶ Relationship between applied suction and suction attained in a sand table

#### Requirements





## Requirements



### Demonstration Infiltration Apparatus - FEL5-MKII

A simple but effective laboratory demonstration of the infiltration processes, which are fundamental to any form of irrigation study.

The unit comprises three transparent cylinders in which soil samples are placed. Water poured onto the soil surface can then be observed as it infiltrates the sample, experiments include:

- ▶ Demonstration of the effect of crusting on infiltration
- ▶ Understand the effects of soil texture and structure on infiltration
- ▶ The effects of existing soil moisture conditions on infiltration
- ▶ Relationship between soil type and infiltration/penetration rates
- ▶ Demonstration of the relationship between soil particle size and infiltration
- ▶ The effect of organic matter content on infiltration and penetration rate
- ▶ The effect of non-homogeneous soil strata on infiltration and penetration rates
- ▶ The effect of moisture content on infiltration and penetration rates
- ▶ The effect of straw mulch on infiltration rate



## Requirements



### Demonstration Lysimeter - FEL6

The lysimeter consists of three 300mm diameter containers in which a variety of crop types can be grown in any soil type.

Each container can then in turn be placed on a hydraulically mounted plate, which is used to monitor system weight changes arising from evapotranspiration, precipitation and drainage.

Despite its simplicity, the apparatus has a high degree of sensitivity and may be used for student project work as well as for demonstration purposes.



## Requirements



### Drain Permeameter - FEL10

The Drain Permeameter apparatus provides the student with a way of studying the interactions between drains, soils and filters in the laboratory.

The apparatus consists of a constant head permeator which allows the study of various combinations of soils, filters and drain types. Changes in permeability with time can be estimated by measuring the rate of drainage of water from the permeator.

The part of the soil/ drain system which is changing its permeability can be inferred from the series of piezometer tubes which are connected to the cylinder of the permeator.





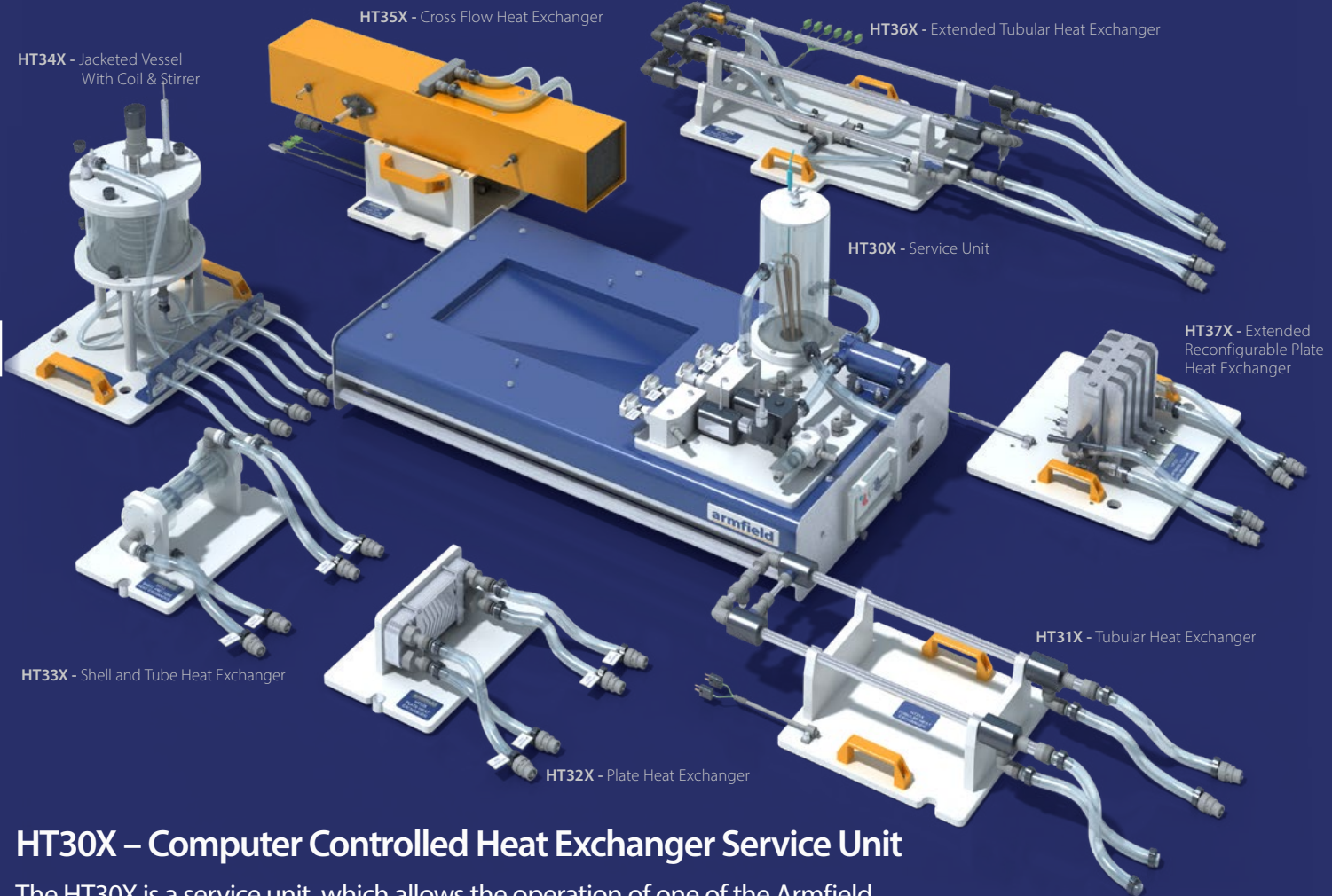
# Heat Exchangers



## Computer Controlled Heat Exchanger

The Armfield range of small scale heat exchangers comprises units which represent the common types of heat exchanger found in industry and demonstrate different techniques for indirect transfer of heat from one fluid stream to another.

**BENCH TOP DESIGN**  
**SUPPLIED WITH COMPUTER CONTROL AND DATA-LOGGING AS STANDARD**  
**SEVEN INTERCHANGEABLE HEAT EXCHANGER MODULES AVAILABLE**  
**CAN BE CONFIGURED FOR COMPUTER CONTROLLED OR STAND ALONE (REQUIRES ACU) OPERATION**



## HT30X – Computer Controlled Heat Exchanger Service Unit

The HT30X is a service unit, which allows the operation of one of the Armfield range of small scale heat exchanger systems.

Their small size produces a fast system response to changes in variables such as water flow rate and temperature, so that training exercises can be carried out in a relatively short space of time.

ArmBUS software is provided as standard with the HT30X for all the Armfield heat exchanger accessories.

Individual programs are provided for each exchanger, and each program contains a selection of separate exercises that can be performed.



armBUS NetCan, connects up-to 20 users to one piece of equipment





## Requirements

### Service Unit - HT30X

NEW

Software  
inc



The HT30X is a service unit which controls the operation of a broad range of Armfield interchangeable small scale heat exchanger modules. It provides controlled cold water flow, hot water direction can easily be reversed using software control, enabling co-current and counter-current investigations, and the required instrumentation for a series of in-depth investigations into heat exchanger performance.

The individual heat exchangers can be quickly changed over, to enable comparisons between different types of heat exchanger to be made.

The HT30X requires a user supplied personal computer for the operator interface. The computer connects the HT30X using a USB interface, providing a simple and straightforward installation and set up procedure.

Once the appropriate heat exchanger has been installed and set up, all other functions can be performed under computer control.



ACU Screen  
Touch screen, stand alone option



## Requirements

### Tubular Heat Exchanger - HT31X

NEW

Software  
inc



The tubular heat exchanger is the simplest form of heat exchanger and consists of two concentric (coaxial) tubes carrying the hot and cold fluids.

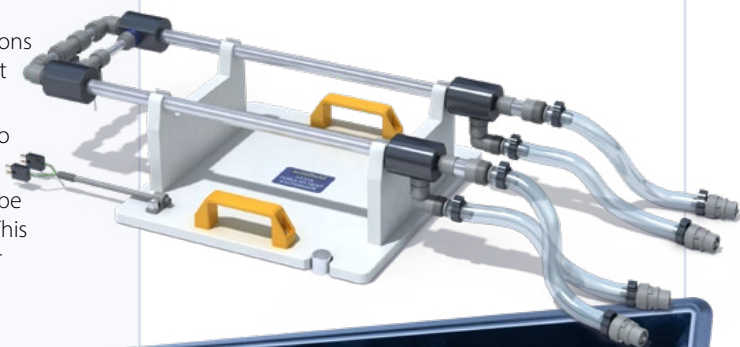
In these miniature versions the tubes are separated into sections to reduce the overall length and to enable the temperature at points along both fluid streams to be measured.

Two versions are available, the HT31X is a basic version with two sections and a single interim temperature measurement point.

On both our HT31X and HT36X heat exchangers, the inner tube is used for the hot fluid and the outer annulus for cold fluid. This minimises heat loss from the exchanger without the need for additional insulation.

#### Features:

- ▶ A small-scale Tubular Heat Exchanger system for use with an Armfield Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of sections of concentric tubes, the outer section constructed from clear acrylic for visibility and the inner tube from stainless steel
- ▶ The tubes are easily dismantled for cleaning
- ▶ A comprehensive instruction manual is included



Software  
inc

NEW

## Plate Heat Exchanger – HT32X

Requirements

HT  
30X

The plate heat exchanger is extremely versatile and commonly used in the food and chemical processing industries.

The HT32X has a single heating section configured for multi-pass operation with passes in series.

It comprises 10 individual plates. When being assembled, each second plate is rotated by 180°, thus forming two separately rotated flow chambers by the means of which the mediums being involved in the heat transfer are conducted in counter flow.

### Features:

- ▶ A small scale plate heat exchanger system for use with an Armfield Computer Controlled Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of stainless steel plates, each with a pressed chevron pattern, soldered with copper using a vacuum soldering procedure
- ▶ A comprehensive instruction manual is included



Software  
inc

NEW

## Shell and Tube Heat Exchanger – HT33X

Requirements

HT  
30X

The shell and tube heat exchanger is commonly used in the food and chemical process industries. This type of exchanger consists of a number of tubes in parallel enclosed in a cylindrical shell. Heat is transferred between one fluid flowing through the tubes and another fluid flowing through the cylindrical shell around the tubes.

The miniature exchanger supplied is designed to demonstrate liquid to liquid heat transfer in a 1-7 shell and tube heat exchanger (one shell and seven tubes with two transverse baffles in the shell).

### Features:

- ▶ A miniature shell and tube heat exchanger for use with an Armfield Computer Controlled Heat Exchanger Service Unit
- ▶ Comprises an outer shell and seven internal tubes, there are two transverse baffles inside the shell
- ▶ The heat exchanger is constructed from stainless steel tube and clear acrylic. It is mounted on a PVC baseplate which is designed to be installed on the plinth of the Heat Exchanger Service Unit without the need for tools
- ▶ The stainless steel tubes can be removed from the heat exchanger for cleaning
- ▶ A comprehensive instruction manual is included





Requirements

HT 30X

## Jacketed Vessel With Coil & Stirrer - HT34X

Vessel heating or cooling of a process liquid in a tank, either batchwise or with continuous product feed, is common practice throughout industry. The characteristics of the heat transfer using an external jacket or internal coil can be demonstrated together with the effect of stirring the vessel contents.

**Features:**

- ▶ Miniature jacketed vessel heat exchanger system for use with an Computer Controlled Armfield Heat Exchanger Service Unit
- ▶ Comprises processing vessel with outer jacket, inner coil, variable speed stirrer and baffle
- ▶ Thermocouples measure the vessel contents and the inlet and outlet temperatures of both fluid streams (5 in total)
- ▶ The Heat Exchanger is designed to be installed on the service unit without the need for tools
- ▶ A comprehensive instruction manual is included



Requirements

HT 30X

## Cross Flow Heat Exchanger - HT35X

The cross flow heat exchanger is commonly used in applications such as heating, ventilating and air conditioning. It is also encountered as vehicle engine radiator.

This type of heat exchange occurs when the flow direction of the two fluids cross each other. In the HT35X, hot water flows in and out of a radiator, perpendicular to the air stream, which is being pulled into the radiator by an axial fan.

The convection between the two fluids through fins surface on the radiator implements the heat exchange.

**Features:**

- ▶ A small scale cross flow heat exchanger system for use with the Armfield Computer Controlled Heat Exchanger Service Unit to teach the fundamentals concepts of heat transfer
- ▶ Some parts in the heat exchanger such as probes and axial fan can be easily removed for cleaning
- ▶ The HT35X enables variation of the parameters involved in the cross flow exchange process and therefore a complete analysis of the phenomena
- ▶ Thermocouples measure the inlet and outlet water from the base unit and air temperatures. The the air velocity sensor connects to the HT30X, 0-10m/s
- ▶ The air mass flow rate is derived using an air velocity sensor
- ▶ The HT35X is mounted on a PVC baseplate which is designed to be installed on the plinth of the Computer Controlled Heat Exchanger Service Unit without the need for tools
- ▶ A comprehensive instruction manual is included



Software  
inc

NEW

## Extended Tubular Heat Exchanger - HT36X

Requirements

HT  
30X

The tubular heat exchanger is the simplest form of heat exchanger and consists of two concentric (coaxial) tubes carrying the hot and cold fluids. In these miniature versions the tubes are separated into sections to reduce the overall length and to enable the temperature at points along both fluid streams to be measured.

The HT36X unit has four longer tube sections, giving four times the overall heat transfer area and three interim temperature measurement points in each fluid stream.

The unit has sufficient heat transfer area to demonstrate the classic counter current flow conditions where the outlet of the heated stream is hotter than the outlet of the cooled stream.

### Features:

- ▶ A small scale Tubular Heat Exchanger system for use with an Computer Controlled Armfield Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of sections of concentric tubes, the outer section constructed from clear acrylic for visibility and the inner tube from stainless steel
- ▶ The tubes are easily dismantled for cleaning
- ▶ A comprehensive instruction manual is included



Software  
inc

NEW

## Extended Reconfigurable Plate Heat Exchanger – HT37X

Requirements

HT  
30X

The HT37X is designed to be reconfigurable by the student and can accommodate up to four sections of heating. Each section provides an additional temperature measurement point for each fluid stream.

In order to make the unit easy to reconfigure, these sections are supplied as pre-assembled groups of plates complete with an intermediate plate (containing the temperature measurement points). Using the four heating sections provided, students can compare heat exchangers of different heat transfer area and different numbers of passes. A quick release clamp system enables the different arrangements to be changed quickly and easily without using tools.

### Features:

- ▶ A small scale plate heat exchanger system for use with an Armfield Computer Controlled Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of stainless steel plates, each with a pressed chevron pattern and a food grade silicon rubber sealing gasket, mounted in a frame
- ▶ Easily dismantled for cleaning
- ▶ A comprehensive instruction manual is included





Contact Armfield



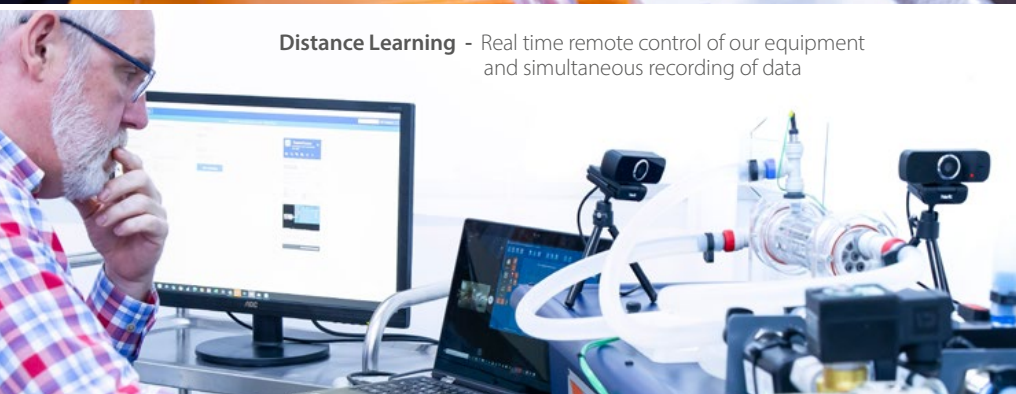
# Educational Laboratory

New for 2023, the Armfield Academy has opened its brand-new Educational classroom.

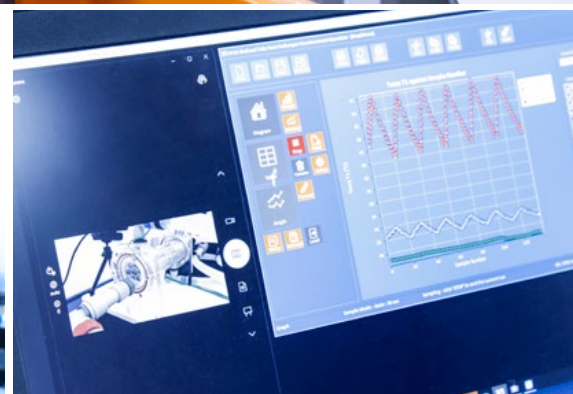
The fully functional classroom is available for training and demonstrations on Armfield's educational products



Contact us for more information:  
[www.armfield.com](http://www.armfield.com)



**Distance Learning** - Real time remote control of our equipment and simultaneous recording of data







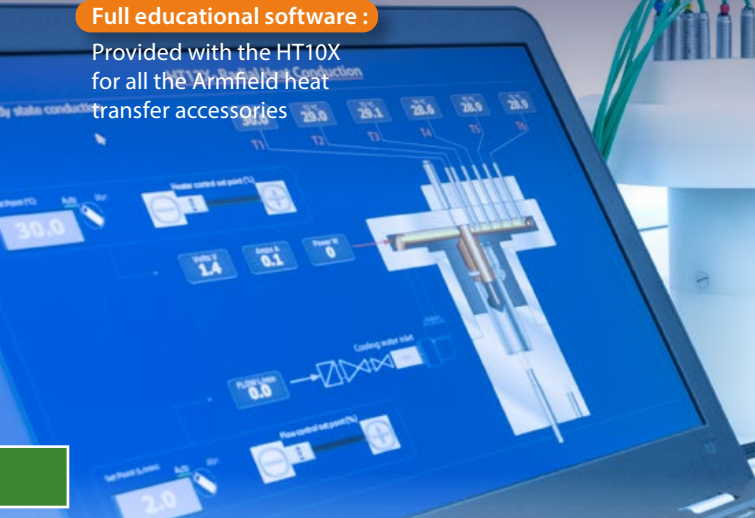
# Heat Transfer

## Computer Controlled Heat Transfer

A range of small scale heat transfer equipment to demonstrate the three basic modes of heat transfer (*conduction, convection and radiation*).

**Full educational software :**

Provided with the HT10X for all the Armfield heat transfer accessories



A full ArmBUS educational software suite is provided with the HT10X for all the Armfield heat transfer accessories.

Individual experiment interfaces and displayed data types vary to match selected experiment accessories.

Embedded software based PID control of heater and water flow control enabling steady state to be achieved in less than two minutes.



armBUS NetCan, connects up-to 20 users to one piece of equipment



### Computer-Controlled Heat Transfer Service Unit - HT10X

The Armfield HT10X PC controlled heat transfer service unit is utilised in conjunction with a wide range of modular, small-scale experiment accessories in order to demonstrate several modes of heat transfer. The factors that affect heat transfer can be investigated and some of the practical problems associated with the transfer of heat can be visualised. The modular heat transfer experiments may be individually connected to the HT10X service unit, which provides the necessary electrical supplies and measurement facilities for investigation and comparison of the different heat transfer characteristics.

**Features:**

- ▶ Small-scale, computer control bench top equipment
- ▶ Multiple accessories available covering a wide range of heat transfer investigations
- ▶ Educational software, including mimic diagrams, real-time control, data logging and graph plotting
- ▶ Connects armBUS via USB

**Requirements**

- HT 10XC
- COLD
- 1Ph





## Requirements

HT 10XC



## Linear Heat Conduction - HT11X

The accessory comprises a heating section and a cooling section, which is clamped together or clamped with interchangeable intermediate sections between them, as required.

The temperature difference created by the application of heat to one end of the resulting wall and cooling at the other end results in the flow of heat linearly through the wall by conduction.

### Demonstration Capabilities:

- ▶ Understanding the use of the Fourier rate equation
- ▶ Measuring the temperature distribution for steady-state conduction of energy through a uniform plane wall and a composite plane wall
- ▶ Overall heat transfer coefficient for differing materials in series
- ▶ Determining the constant of proportionality (thermal conductivity  $k$ ) of different materials (conductors and insulators)
- ▶ Relationship of temperature gradient to cross-sectional area
- ▶ Effect of contact resistance on thermal conduction
- ▶ Understanding the application of poor conductors (insulators)
- ▶ Observing unsteady-state conduction (qualitative only)



## Requirements

HT 10XC



## Linear Heat Conduction - HT12X

The arrangement, using a solid metal disk with temperature measurements at different radii and heat flow radially outward from the centre to the periphery, enables the temperature distribution and flow of heat by radial conduction to be investigated.

On the HT12X the heater power and the cooling water flow rate are regulated by PID controlled via the HT10X via the computer software.

The accessory comprises a solid disk of material, which is heated at the centre and cooled at the periphery to create a radial temperature difference with corresponding radial flow of heat by conduction.

### Demonstration Capabilities:

- ▶ Understanding the use of the Fourier rate equation in determining rate of heat flow through solid materials
- ▶ Measuring the temperature distribution for steady-state conduction of energy through the wall of a cylinder (radial energy flow)
- ▶ Determining the constant of proportionality (thermal conductivity  $k$ ) of the disk material



## Requirements

HT 10XC



## Laws of Radiant Heat Transfer & Radiant Heat Exchange - HT13X

The equipment supplied comprises an arrangement of energy sources, measuring instruments, aperture plates, filter plates and target plates, which are mounted on a linear track, in different combinations to suit the particular laboratory teaching exercise chosen.

### Demonstration Capabilities:

- ▶ Inverse-square law using the heat source and radiometer or light source and light meter
- ▶ Stefan-Boltzmann law using the heat source and radiometer
- ▶ Determination of the View Factor
- ▶ Emissivity using the heat source, metal plates and radiometer
- ▶ The Inverse Square Law for Light
- ▶ Kirchhoff's circuit laws using the heat source, metal plates and radiometer
- ▶ Area factors using the heat source, aperture and radiometer
- ▶ Lambert's Cosine Law using the light source (rotated) and light meter
- ▶ Lambert's law of absorption using the light source filter plates and light meter



# Heat Transfer - HT Series

Software Inc

HT14X Heated Cylinder with Guard



## Combined Convection and Radiation – HT14X

The HT14X is one of a range of small scale heat transfer laboratory teaching accessories which demonstrate the basic modes of heat transfer (conduction, convection and radiation).

The equipment consists of a centrifugal fan with a vertical outlet duct. At the top of the duct there is a heated cylinder.

The mounting arrangement for the cylinder in the duct is designed to minimise loss of heat by conduction to the wall of the duct.

### Experimental Capabilities:

- ▶ Determining the combined heat transfer ( $Q_{\text{radiation}} + Q_{\text{convection}}$ ) from a horizontal cylinder in natural convection over a wide range of power inputs and corresponding surface temperatures
- ▶ Measuring the domination of the convective heat transfer coefficient  $H_c$  at low surface temperatures and the domination of the radiation heat transfer coefficient  $H_r$  at high surface temperatures
- ▶ Determining the effect of forced convection on the heat transfer from the cylinder at varying air velocities

### Requirements

HT 10XC



1Ph



NEW

Software Inc

## Extended Surface Heat Exchanger – HT15X

A long horizontal rod, which is heated at one end, provides an extended surface (pin) for heat transfer measurements.

Thermocouples at regular intervals along the rod allow the surface temperature profile to be measured.

The rod is manufactured from brass and coated with a heat-resistant matte black paint, which provides a consistent emissivity close to unity. It is mounted horizontally with support at both ends positioned to avoid the influence of adjacent surfaces.

### Experimental Capabilities:

- ▶ Measuring the temperature distribution along an extended surface (pin) and comparing the result with a theoretical analysis
- ▶ Calculating the heat transfer from an extended surface resulting from the combined modes of free convection and radiation heat transfer and comparing the result with a theoretical analysis
- ▶ Determining the constant of proportionality of the rod material (Thermal Conductivity  $K$ )

### Requirements

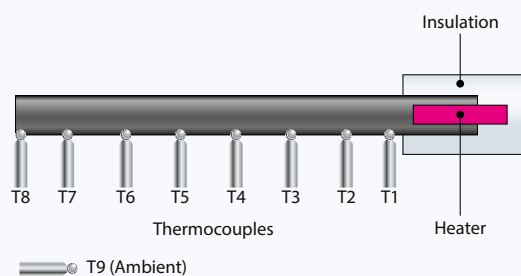
HT 10XC



1Ph



NEW





## Requirements

- HT 10XC
- COLD
- 1Ph

### Radiation Errors in Temperature Measurement – HT16X

The Radiation Errors in Temperature Measurement accessory comprises a tubular metal duct through which air, at ambient temperature, is blown vertically upwards by a centrifugal fan.

The velocity of the air can be changed by adjusting a throttle plate at the fan inlet and measured by an anemometer in the fan outlet duct.

Thermocouples indicate the wall temperature at the heated end of the duct and the temperature of the air stream before it reaches the heater section.

Three test thermocouples are suspended at the centreline of the heated section. A radiation shield may be positioned to shield these from the heated duct wall.

#### Experimental Capabilities:

- ▶ **Errors associated with radiative heat transfer:**
  - Effect of wall temperature on measurement error
  - Effect of air velocity on measurement error
  - Effect of thermocouple style on measurement error
- ▶ **Methods for reducing errors due to radiation:**
  - Design of a radiation-resistant thermometer
  - Use of a radiation shield to surround the thermometer



Heated Cylinder with Guard

## Requirements

- HT 10XC
- COLD
- 1Ph

### Unsteady-State Heat Transfer – HT17X

The HT17X equipment consists of a heated water bath together with a set of instrumented shaped test pieces. Each of the shapes incorporates a thermocouple to measure the temperature at the centre of the shape.

Analytical solutions are available for temperature distribution and heat flow as a function of time and position for simple solid shapes, which are suddenly subjected to convection with a fluid at a constant temperature.

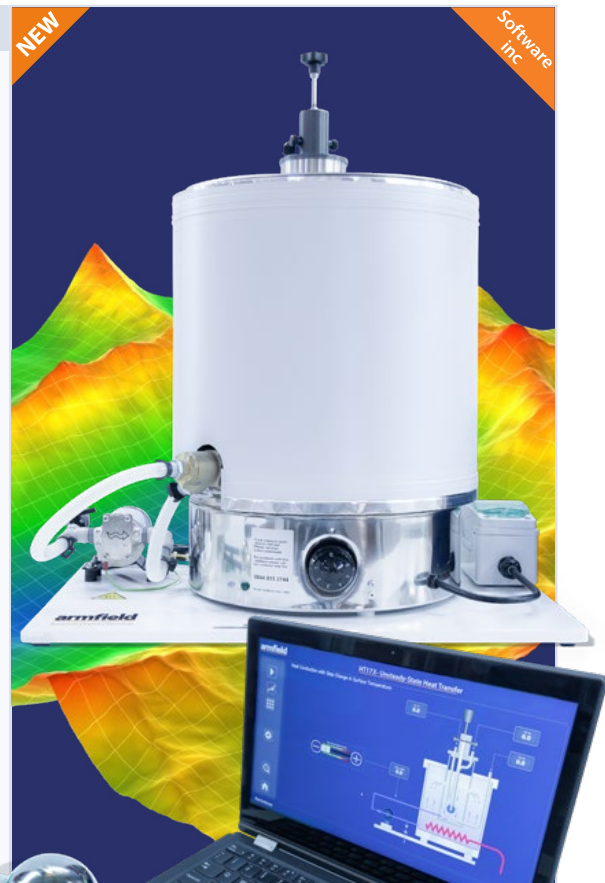
Simple shapes are provided together with appropriate classical transient-temperature/heat-flow charts, which enable a fast analysis of the response from actual transient measurements. Each shape is allowed to stabilise at room temperature then suddenly immersed in a bath of hot water at a steady temperature.

Monitoring of the temperature at the centre of the shape allows analysis of heat flow using the appropriate transient-temperature/heat-flow charts provided.

#### Experimental Capabilities:

- ▶ To observe unsteady state conduction of heat to the centre of a solid shape, when a step change is applied to the temperature at the surface of the shape
- ▶ Using analytical transient-temperature/heat flow charts to determine the conductivity in cylinders with different conductivity
- ▶ Investigating the effect of shape, size and material properties on unsteady heat flow using analytical transient-temperature/heat flow charts

HT17X Sphere shape



# Heat Transfer - HT Series

**Software inc**

## Thermo-Electric Heat Pump - HT18X

Based on a Peltier device, the Armfield HT18X Thermo-Electric Heat Pump demonstrates how electrical power can be used to extract heat from a cool surface and transfer it to a hot surface. This effect is becoming widely used for point cooling (e.g. of semiconductor devices) and small-scale volumetric cooling.

**Experimental Capabilities:**

- ▶ Performance of a Peltier device as a cooler
- ▶ Heat transfer characteristics as a function of temperature and drive current
- ▶ Measurement of the coefficient of performance
- ▶ Energy balance
- ▶ Demonstration of a Peltier device as an electrical generator

**Requirements**

HT 10XC

COLD

1Ph

HT18X Experiment chooser and calculation screens

**Software inc**

## Free and Forced Convection - HT19X

The Armfield Free and Forced Convection unit has been specifically designed to demonstrate the phenomena of natural (free) and forced convection.

**Experimental Capabilities:**

- ▶ Relationship between surface temperature and power input in free convection
- ▶ Relationship between surface temperature and power input in forced convection
- ▶ Understanding of the use of extended surfaces to improve heat transfer from the surface
- ▶ Determining the temperature distribution along an extended surface
- ▶ Comparing characteristics of a vertical and horizontal flat plate in free convection
- ▶ Determining the characteristic velocity, the Reynolds, Grashof and Rayleigh numbers for a flat plate in free convection
- ▶ Calculation of the average heat-transfer coefficient of the pinned heater in forced convection
- ▶ Comparing horizontal and vertical configurations for a finned exchanger in free convection

Heated surface models:  
 1 - Cylindrical pin surface Heat Exchanger  
 2 - Finned surface Heat Exchanger  
 3 - Flat plate surface Heat Exchanger

**Requirements**

HT 10XC

COLD

1Ph



## Requirements



### Conductivity of Liquids and Gases - HT20X

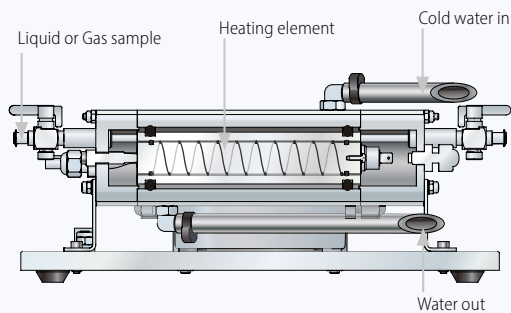
The Armfield Conductivity of Liquids and Gases unit has been specifically designed to enable students to measure and compare the thermal conductivities of various liquids and gases.

It's designed to facilitate quick and effective cleaning and to minimise thermal losses.

#### Experimental Capabilities:

- ▶ Understanding the use of the Fourier rate equation in determining the rate of heat flow by conduction through liquids or gases
- ▶ Measuring the constant of proportionality (the thermal conductivity  $k$ ) of different liquids such as water and glycerol
- ▶ Calibrating the unit for heat losses using a gas, such as air with known thermal conductivity, then measuring the temperature difference across different gases, such as carbon dioxide and helium to determine their thermal conductivity  $k$

**Note:** *Flammable, explosive, corrosive or toxic liquids and gases must not be used in the equipment.*



## Requirements



### Thermal Conductivity of Building Materials - HT21X

The HT21X is a bench top accessory designed to allow students easily investigate the relative thermal conductivities of typical building materials.

The unit is used in conjunction with the HT10X Computer-Controlled Heat Transfer Service Unit.

The HT21X uses a PID controlled flat plate electrical heater and a water-cooled flat plate and the AI variables are controlled via the HT10X software.

The heat flux between the hot plate and the cold plate passes through the sample and is measured by integrated heat flux sensor.

Test specimens are sandwiched between the hot and cold plate in a thermally insulated enclosure to minimise heat losses. The unit is supplied with a specialised loading system designed to ensure that the same clamping force is applied to all test specimens.

Integrated thermocouples are designed to measure the temperatures either side of the test specimen.

#### Experimental Capabilities:

- ▶ Determine the thermal conductivity  $\lambda$  of different materials
- ▶ Determine the thermal resistance
- ▶ Thermal conductivity  $\lambda$  for several samples connected in series (up to a thickness of 50mm)
- ▶ Overall heat transfer coefficient for differing materials in series





# Thermodynamics



The TH range is designed to introduce the fundamental principles of thermodynamics to the student.

This range of equipment starts at basic concepts such as temperature and pressure measurement and leads on to introducing the relationships between these fundamentals, the first and second law of thermodynamics, the principles of reversibility, entropy, enthalpy etc.

The equipment allows the student to gain a true understanding of these principles.



and Dropwise Condensation Unit

armBUS Software Supplied with unit:  
Screen shows mimic diagram and real time sensor information

Software Inc.



## Film and Dropwise Condensation Demonstration Unit - TH6

The unit has been designed as a highly visual means for students to observe the two condensation processes and study the effects of varying the vacuum and heat input whilst gathering data concerning temperatures, pressure and flowrates to be able to undertake a variety of calculations involved in the condensation process. Additionally, the unit will allow the operator to understand the influence of air as a non-condensable gas on the condensation processes.

Using the latest ArmBUS technology to collect, display and store data in a clear format as well as control certain parameters. Other parameters can be controlled manually by the student by manipulation of valves on the working face of the unit.

Safety features are also designed into both software and hardware to greatly reduce the risk of over-pressurisation and thus safeguard students undertaking experimental work.

### Requirements





Requirements

## Temperature Measurement and Calibration - TH1

1Ph

The Temperature Measurement and Calibration apparatus that has been designed to introduce students to temperature and how different techniques can be employed to measure this variable.

The system is supplied with three different heat sources and five different temperature sensors.

To demonstrate the thermometric properties of different temperature sensors and the use of fixed points for calibration.

Educational Software & Data logging is optionally available - TH-DTA-ALITE



Requirements

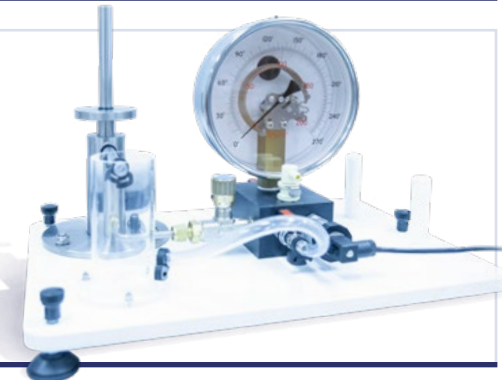
## Pressure Measurement and Calibration - TH2

1Ph

The Pressure Measurement and Calibration apparatus has been designed by Armfield to introduce students to pressure and how different techniques can be employed to measure this variable.

Different fixed pressures are generated using a simple dead-weight pressure calibrator for calibrating the measuring devices. A Bourdon-type pressure gauge and electronic-type pressure sensor are connected to the calibrator to allow their characteristics, including accuracy and linearity, to be determined.

Educational Software & Data logging is optionally available - TH-DTA-ALITE



Requirements

## Saturation Pressure - TH3

1Ph

The Saturation Pressure apparatus that has been designed to introduce students to the concept of saturation pressure and how different techniques can be employed to measure this variable.

The system allows students to investigate the behaviour of a fluid at its boiling point and how the temperature varies with pressure. It also provides the capability to determine the condition of the wet steam produced by the apparatus. Saturation curves can be obtained and compared with published steam tables.

Educational Software & Data logging is optionally available - TH-DTA-ALITE



Requirements

## Recycle Loops - TH4

1Ph

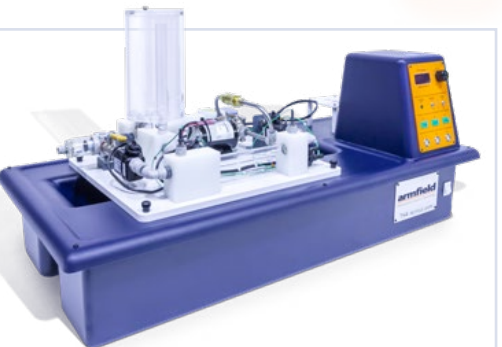
COLD

DRAIN

The Recycle Loops apparatus that has been designed to demonstrate clearly, both visually and experimentally, what recycle is and to allow mass and energy balances to be performed under steady state and unsteady state conditions.

The system includes experimentation and calculation of the heat transfer rate at a range of recycle rates, using the steady flow energy equation.

Educational Software & Data logging is optionally available - TH-DTA-ALITE



Requirements

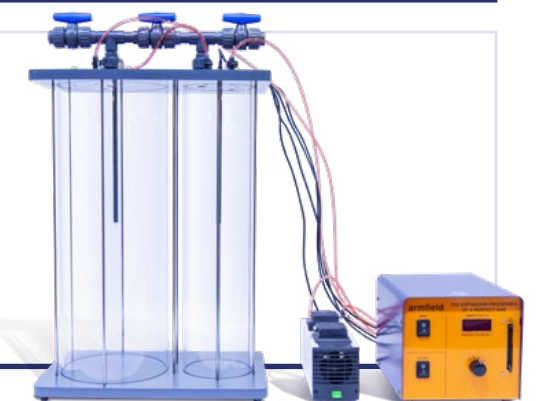
## Expansion Processes of a Perfect Gas - TH5

1Ph

The TH5 Expansion Processes of a Perfect Gas apparatus that has been designed to introduce students to a range of basic thermodynamic processes using air as the working fluid.

The system enables investigation into the behaviour of a gas under pressure and vacuum, to determine the ratio of specific heats. Includes concepts such as Adiabatic, Isothermal, Reversible and Irreversible Processes.

Educational Software & Data logging is optionally available - TH-DTA-ALITE



**RA  
SERIES**

# Refrigeration & Air Conditioning

The Armfield RA series is designed to clearly demonstrate the principles behind modern refrigeration and air conditioning systems.

The series includes four separate units:

- ▶ RA1-MKII Vapour-Compression Refrigeration Unit
- ▶ RA2 Air Conditioning Unit
- ▶ RA3 Recirculating Air Conditioning Unit
- ▶ RA4 Air Conditioning Training Unit

Link to RA Series



### Vapour-Compression Refrigeration Unit - RA1-MKII

The Vapour-Compression Refrigeration System is the most common refrigeration system used today.

RA1-MKII is a computer-controlled vapour-compression refrigeration unit with automatic recording of appropriate process variables using an integral USB interface device.

This allows the student to gain a thorough understanding of the refrigeration process by changing the operation of different parts of the process and recording the response of the complete system.

- ▶ Computer controlled with real time data logging of results

Requirements

- 1Ph
- PC
- USB





## Requirements

1Ph

PC

USB

### Air Conditioning Unit - RA2

The Armfield RA2 unit represents a model of an air conditioning system by demonstrating the effects of essential air conditioning processes:

- ▶ Cooling
- ▶ Heating
- ▶ Humidifying
- ▶ Dehumidifying

The effect and relationships of the primary processes involved in air handling systems can be investigated.

The RA2 unit is designed so that the student can simulate different environments and perform measurements to allow psychrometric data analysis.

**Computer controlled with real time data logging of results**



Software inc



## Requirements

1Ph

PC

USB

### Recirculating Air Conditioning Unit - RA3

The Armfield RA3 unit represents a model of a recirculating air conditioning system by demonstrating the effects of essential air conditioning processes: cooling, heating, humidifying and dehumidifying.

The effect and relationships of the primary processes involved in air handling systems can be investigated.

The system additionally features an enclosed climate control chamber, adjustable recirculation of air leaving the chamber back into the conditioning duct and pressure gauges and temperature sensors to allow the refrigerant temperature change across the condenser and evaporator to be established.

The refrigerant flow rate is also measured using a variable area flow meter.

**Computer controlled with real time data logging of results**



Software inc



## Requirements

1Ph

### Air Conditioning Training Unit - RA4

The RA4 is a standalone desktop refrigeration demonstrator based on a vapour compression refrigeration system (VCRS). The most common refrigeration system used today; this is where the refrigerant undergoes phase changes to absorb and reject heat in a controlled manner.

The RA4 Unit is designed so that the student can understand the fundamental components and operation of a refrigeration/air conditioning system.

The system can be used as a demonstration, fault diagnosis and as a service training unit.







# Internal Combustion Engines

Link to CM Series



Armfield's range of internal combustion engines encompasses automotive and aviation power units, mounted on test beds they provide a complete engine learning system.

CM11-MKII / CM12 / CM14 all come with ArmSoft software, which can be used to run the engine from a PC. The software incorporates the full range of facilities as outlined in the ArmSoft software section.

CM20 has the armBUS control system integrated into the product see armBUS page.

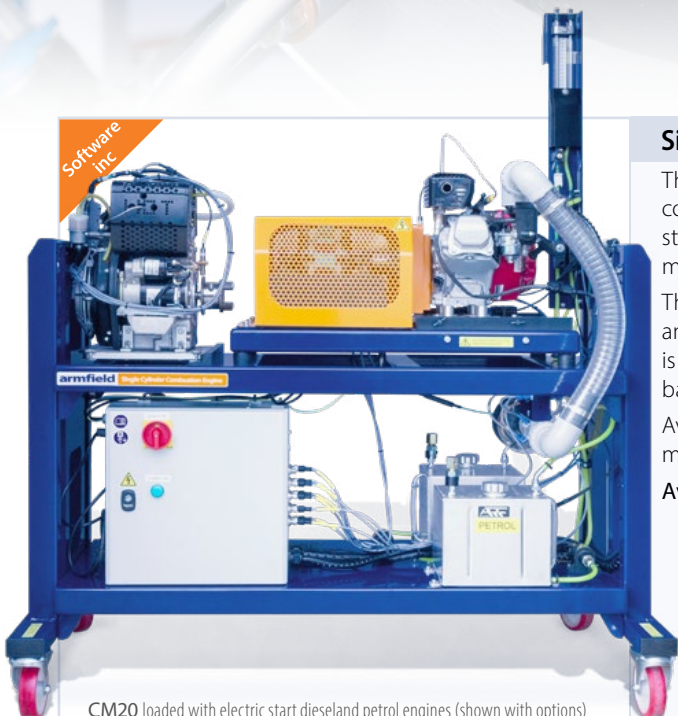
CM11-MKII Mimic Screen

CM12 Mimic Screen

CM14 Mimic Screen

CM20 Screen armBUS

Software inc



CM20 loaded with electric start diesel and petrol engines (shown with options)

## Single Cylinder Combustion Engine - CM20 – armBUS integrated

Requirements

The Gasoline Engine Apparatus is a self-contained computer controlled engine test rig which has been designed to allow the study and comparison of the basic operating characteristics of modern spark ignition and compression ignition engines.

The unit consists of a selection of engines which can be coupled to an eddy current dynamometer which acts as a brake. This assembly is mounted on a painted steel framework. Fuel tanks, electrics and batteries are all mounted underneath the engine.

Available options include an engine indicator set which allows cyclic measurement of cylinder pressure.

- Available Options:**
- Petrol Engine with Electrical Start **CM20-10-1**
  - Petrol Engine Indicator Set **CM20-10-12**
  - Diesel Engine with Electrical Start **CM20-20-1**
  - Diesel Engine Electrical Start Sensor Prep **CM20-20-3**
  - Diesel Engine Indicator Set **CM20-20-12**
  - Pressure Sensor Amp **CM20-12-12**
  - Fuel Level **CM20-30**
  - 5 Gas Analyser **CM50**

- 1Ph
- PC
- USB
- EXTRACTOR
- HEARING PROTECTION





## Requirements

### Gasoline Engine - CM11-MKII

- 1Ph
- PC
- USB
- EXTRACTOR
- HEARING PROTECTION
- COLD

The Gasoline Engine Apparatus is a self-contained engine test rig which has been designed to allow the study of the basic operating characteristics of a modern four-stroke spark ignition engine.

The unit consists of an engine which is coupled to an eddy current dynamometer which acts as a brake. This assembly is mounted on a painted steel framework. Fuel tanks, batteries and electrics are all mounted underneath the engine.

Available options include an engine indicator set which allows measurement of cylinder pressure and an LPG fuel system.

The CM11-MKII is supplied with electronic sensors to monitor key parameters and a USB interface which allows direct connection to a PC. All control functions are designed to be performed from the computer.

Data logging and control software is supplied, allowing students to control the engine and view and record real time sensor outputs.

**Available Options:** Engine Indicator Set **CM11-MKII-12**  
LPG Fuel System **CM11-MKII-13**



## Requirements

### Automotive Diesel Engine - CM12

- 1Ph
- PC
- USB
- EXTRACTOR
- HEARING PROTECTION
- COLD

The Armfield Diesel Engine Apparatus is a self-contained engine test rig which has been designed to allow the study of the basic operating characteristics of a modern four-cylinder compression ignition engine.

The unit consists of an engine which is coupled to an eddy current dynamometer which acts as a brake. This assembly is mounted on a painted steel framework. The fuel tank, battery and electrics are all mounted underneath the engine.

An optional engine indicator set is available which allows cylinder pressure to be measured and plotted against volume.

The CM12 is supplied with electronic sensors to monitor key parameters and a USB interface card which allows direct connection to a PC. All control functions can be performed from both a local control panel and remotely from the computer. Data logging and control software is supplied, allowing students to control the engine and view and record real time sensor outputs.

**Available Options:** Engine Indicator Set **CM12-12**



## Requirements

### Axial Flow Gas Turbine - CM14

- 1Ph
- PC
- USB
- EXTRACTOR
- HEARING PROTECTION

The CM14 is a complete, aeronautical axial flow gas turbine engine with full instrumentation and sensors.

Those sensors measure the gas temperature and pressure at different stages within the engine, together with the thrust generated and the fuel consumption.

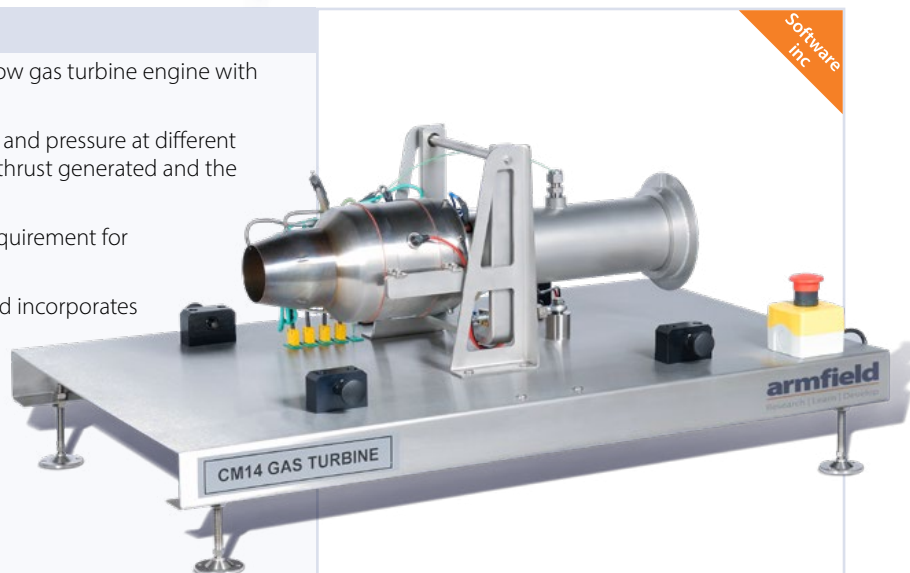
It features simple electric starting with no requirement for propane gas or compressed air.

The turbine itself can be bench mounted and incorporates a transparent safety guard for full visibility.

The unit's small size minimises the laboratory space required.

The control box can be located in an adjacent room if required.

**Available Options:** With Floor Stand **CM14-10**



**CE**  
SERIES

# Chemical Engineering

Link to CE Series



Armfield's CE and UOP ranges of products, offer the most comprehensive, diverse and technically current group of products of any manufacturer.

The CE range brings the many principles of chemical engineering to the modern educational laboratory.



Fully computer controlled and supplied with educational software specific to each reactor type, comprehensive instruction manual is included which details installation and operating procedures

Laminar Flow Reactor

Plug Flow Reactor

Tubular Reactor

Transparent Batch Reactor

Continuous Stirred Tank Reactor



## Computer Controlled Chemical Reactors Training Equipment - CEXC

Requirements

The Armfield CEXC Computer Controlled Chemical Reactors Teaching Equipment demonstrates the characteristics of the important types of chemical reactors. The self-contained benchtop service unit is designed to provide services for up to five different chemical reactors:

- ▶ Continuous stirred tank reactor
- ▶ Tubular reactor with plug
- ▶ Transparent batch reactor
- ▶ Plug flow reactor
- ▶ Laminar flow reactor

- 1Ph
- PC
- USB
- COLD



## Requirements

CEXC

### Continuous Stirred Tank Reactor - CEM-MKII

The continuous stirred tank reactor is used widely and is particularly suitable for liquid phase reactions. It is particularly used in the organic chemicals industry. Advantages include consistent product quality, straight forward automatic control and low manpower requirements.

The Continuous Stirred Tank Reactor is specially designed to allow detailed study of this important process. It is one of five reactor types which are interchangeable on the Reactor Service Unit (CEXC).

Reactions are monitored by a conductivity probe as the conductivity of the solution changes with conversion of the reactants to product and by temperature.

#### Chilled Water Circulating Unit - CW-17 (Optional)



## Requirements

CEXC

### Tubular Reactor - CET-MKII

Tubular reactors are often used when continuous operation is required but without back-mixing of products and reactants.

The Tubular Reactor is specially designed to allow detailed study of this important process. It is one of five reactor types which are interchangeable on the Reactor Service Unit (CEXC).

Reactions are monitored by a conductivity probe as the conductivity of the solution changes with conversion of the reactants to product.

This means that the inaccurate and inconvenient process of titration, which was formally used to monitor the reaction progress, is no longer necessary.



## Requirements

CEXC

### Transparent Batch Reactor - CEB-MKIII

Batch reactors are used widely in industry at all scales. Batch reactors are tanks, commonly provided with agitation and a method of heat transfer (usually by coils or external jacket).

This type of reactor is primarily employed for relatively slow reactions of several hours' duration, since the downtime for filling and emptying large equipment can be significant. Agitation is used to maintain homogeneity and to improve heat transfer.

The Transparent Batch Reactor is specially designed to allow detailed study of this important process. It is one of five reactors types which are interchangeable on the Computer Controlled Reactor Service Unit (CEXC).

Reactions are monitored by a conductivity probe as the conductivity of the solution changes with conversion of the reactants to product and visually due to the use of indicators.





### Plug Flow Reactor - CEY

The Plug Flow Reactor is an example of an ideal tubular reactor. It demonstrates step and pulse changes for plug flow characterisation and steady-state conversion for a second order reaction. It is a tubular packed column reactor made of clear acrylic and mounted on a steel frame.

A static premixer at the bottom of the column provides premixing of the reagents entering the reactor and improves the flow distribution. It is one of five reactor types which are interchangeable on the Computer Controlled Reactor Service Unit (CEXC).

Reactions are monitored as the conductivity of the solution changes with conversion of the reactants to product. In addition, all the experiments are followed visually by means of the reactor transparency and the use of colour indicators in all the experiments.

### Laminar Flow Reactor - CEZ

The Laminar Flow Reactor is an example of an ideal tubular reactor.

It demonstrates step and pulse changes for plug flow characterisation and steady-state conversion for a second order reaction.

A tubular reactor made of clear acrylic and mounted on a floor standing steel frame, with two diffusers packed with glass beads located at the ends. A static premixer at the bottom of the column provides premixing of the reagents entering the reactor and improves the flow distribution. It is one of five reactor types which are interchangeable on the Computer Controlled Reactor Service Unit (CEXC).

Reactions are monitored as the conductivity of the solution changes with conversion of the reactants to product. In addition, all the experiments are followed visually by means of the reactor transparency and the use of colour indicators in all the experiments.

Requirements

CEXC



### Stirred Tank Reactors in Series - CEP-MKII

The Stirred Tank Reactors in Series unit is designed to demonstrate the mechanism of a chemical reaction in series connected continuous stirred tank reactors as well as the effects of varying the process conditions such as stirring rate and feed rate.

The conductivity of the reacting solution in the reactors changes with the degree of conversion and this provides a convenient method for monitoring the progress of the reaction either manually or by computer.

#### Experimental content:

- ▶ Investigation of dynamic behaviour of stirred tank reactors in series
- ▶ Effect of step input change
- ▶ Response to an impulse change
- ▶ Influence of flow rate
- ▶ Investigation of time constant using a dead time coil
- ▶ Investigation of chemical reaction in a three-tank system

Requirements

1Ph

PC

USB





Requirements

1Ph

PC

USB

**Catalytic Reactors - CEU**

The Armfield catalytic reactor demonstrates the principles of packed bed catalysis.

The unit is fitted with two reactor columns as standard which are used to demonstrate chemical catalysis. A third column, which is available as an option, uses a biological enzymic catalyst.

CEU can be used to examine steady state and unsteady state reactor performance, to compare chemical and biological catalysis (requires CEU-5 option), to characterise the flow in a packed bed, to determine the relative effects of rate of diffusion and reaction rate (Thiele modulus), and to demonstrate the principles of flow injection analysis (requires CEU-3 option).

The supplied software allows experimental data logging and also takes the student through each of the exercises defined in the Laboratory Teaching Exercises.

**Available options:** Flow Injection Analysis Accessory CEU-3  
Third Reaction Column CEU-5



Software inc

Requirements

1Ph

PC

USB

COMP.  
AIR

**Fixed and Fluidised Bed Apparatus - CEL-MKII**

The Armfield CEL-MKII is designed to facilitate the study of flow through fixed and fluidised beds of solid granules.

Low flowrates allow the characteristics of a solid bed to be investigated. Increasing flowrates allow the onset of fluidisation and the characteristics of a fluidised bed to be investigated.

The CEL-MKII has three test columns, one for use with water and two for use with air.

With granules of the same size in the water column and one air column, the differences between 'particulate' and 'aggregative' fluidised beds can be demonstrated. The two air columns allow the effect of different granule sizes to be demonstrated without having to remove, empty and re-pack a column.

Electronic instrumentation is incorporated allowing all relevant flowrates and differential pressures to be displayed.

A USB connector allows the measured variables to be viewed and logged on a PC using the software supplied.

**Optional Accessory:** Air Compressor AC1



Software inc



### Wetted Wall Gas Absorption Column - CES

The process of absorption of gases in absorption towers is widely used in industry. The process facilitates the removal of one or more components from a mixture of gases.

This is achieved by diffusion into a suitable liquid.

The calculation of the size of the absorption tower for a given separation depends upon the height of the transfer unit which can be found if the transfer coefficient is known.

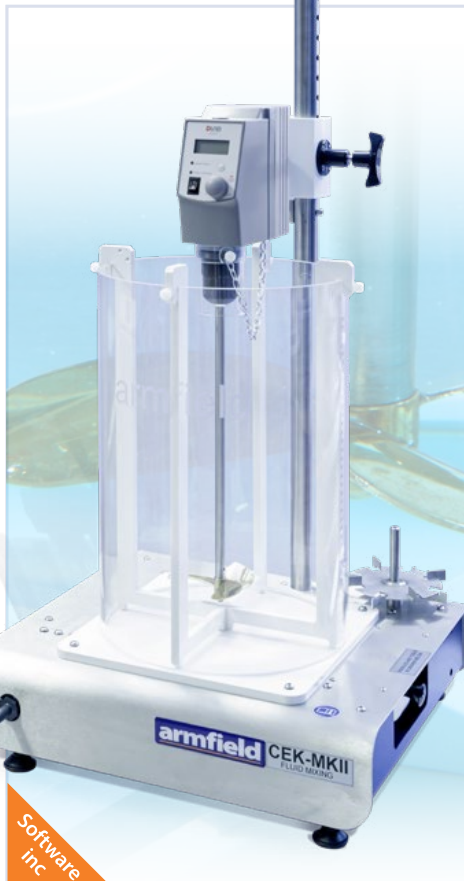
The Wetted Wall Gas Absorption Column provides a means of determining this coefficient and has been widely used in the development of correlations for packed towers.

Problems encountered in the determination of gas-film mass transfer coefficients include those of maintaining isothermal temperatures throughout the column. Some commonly used systems such as ammonia/water have large enthalpies of solution, making the maintenance of isothermal conditions impossible to achieve.

The Wetted Wall Column is designed to study the absorption of oxygen from air into oxygen-free water. In this system the solubility and enthalpy of solution are small and by saturating the inlet air with water, humidification effects may be eliminated.

Students can use this apparatus to determine the power-law relationship between the transfer coefficient and the mass flow rate of the absorbing water at a number of different air flow rates.

#### Requirements



### Fluid Mixing Studies - CEK-MKII

Mixing of liquid / liquid or solid / liquid systems is a complex operation to analyse and subject to many variables. The choice of mixer for a particular application depends on the degree of bulk movement or shear mixing required by the process.

The CEK-MKII can be used to predict the power consumption of a full-sized mixer by equating Reynolds' number and Froude number. The effect of blade size, geometry and the effect of baffles in the mixing vessel are also investigated.

Effect of change in liquid viscosity or liquid density can be demonstrated by changing the liquid in the mixing vessel. An optional heat transfer coil with temperature sensor and meter is available that can be used to vary the characteristics of the liquid by raising or lowering the temperature of the liquid.

A suitable hot water circulator (not supplied) or chiller (not supplied) can be connected to the coil using flexible tubing to affect the required change in temperature.

**Optional Accessories:** Heat Transfer Coil Option CEK-MkII-3  
Chilled Water Circulating Unit CW-17

#### Requirements





## Requirements

### Solids Handling Study Bench - CEN-MKII

1Ph

COMP.  
AIR

SAND

The flow and handling characteristics of granular materials are relevant to many process industries, particularly in the handling of powders, pellets, crystals and aggregates.

The CEN-MKII introduces students to the behaviour of granular materials. The various teaching exercises are split between three units that can be purchased separately or as a complete set allowing only relevant equipment to be purchased.

The following equipment is available:

- CEN-MKII-00 Solids Handling Study Bench (incorporates CEN-MkII-11, -MkII-12 & -MkII-13)
- CEN-MKII-11 Solids Handling
- CEN-MKII-12 Powder Handling
- CEN-MKII-13 Vibratory Shaker and Sieves



## Requirements

### Corrosion Studies Kit - CEQ

1Ph

The CEQ provides an introduction to corrosion, a significant factor in determining durability and safety of industrial processes.

The unit allows students to recognise and make provisions for potentially corrosive situations.

The equipment allows for the simultaneous study of up to eight corrosion cells. A pH meter and electrode are supplied to ensure the correct strength of initial test solutions.

For the study of electro-chemical corrosion effects, a low voltage supply is included, together with all necessary electrical connections.



## Requirements

### Mass Transfer and Diffusion Coefficients - CERa-MKII & CERb

PC

USB

1Ph

Two separate items of laboratory equipment have been designed to enable measurement of molecular diffusivities. They are used to familiarise students with the basic notions of mass transfer theory.

The CERa-MKII utilises a high-definition digital microscope linked to a PC to observe and measure the movement of the phase boundary of the liquid inside a capillary tube as the liquid diffuses into stationary air. The time-lapse recording facility in the software and the use of a heated block rather than a water bath means that the equipment can be left unattended for extended periods. This allows measurements to be carried out using different liquids to especially liquids such as water with a low diffusion coefficient.

The CERb consists of a honeycomb of accurately dimensioned capillaries, positioned between two liquids of differing concentration of solute whose diffusion coefficient is to be determined. The solute is stirred by a battery-operated magnetic stirrer. Conductivity of the vessel contents is monitored using the supplied conductivity meter and electrode. The change in conductivity with time is used to determine the Diffusion Constant for the salt solution tested.



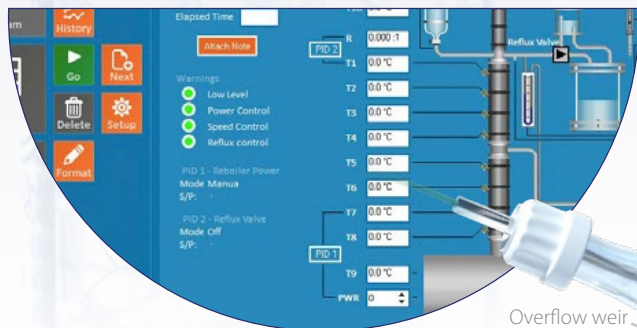
**UOP  
SERIES**

# Unit Operations



The Armfield Unit Operations range provides a series of products designed to allow in depth teaching and investigation into the individual basic steps in a process relating to Chemical Engineering and associated fields.

Each product can be considered to have a single function in a process which potentially has multiple steps, involving a physical change or chemical transformation such as separation, crystallization, evaporation, filtration, distillation, extraction, absorption and drying.



Mimic software screen supplied with UOP3CC



Raschig Packed Column

Sieve Plate Column



Overflow weir

Downcomer tube

Thermocouple

Sieve plate

Vapour

Condensation

Central support rod

## Distillation Columns - UOP3CC & UOP3BM

Two laboratory-scale distillation columns enabling safe operation of a real industrial process.

**UOP3CC:** A continuous distillation column, which also performs batch experiments, can be controlled manually or externally by a PC. Individual loops can be controlled using an industrial PLC or a PID controller.

**UOP3BM:** A batch-only version is suitable for teaching the fundamentals of distillation. Both versions incorporate flameproof devices and intrinsically safe circuits plus feature plate and packed columns together with the display of temperatures on each of the eight sieve plates in the column.

### Requirements

1Ph

PC

USB

COLD

SAFE VENTING



Software inc

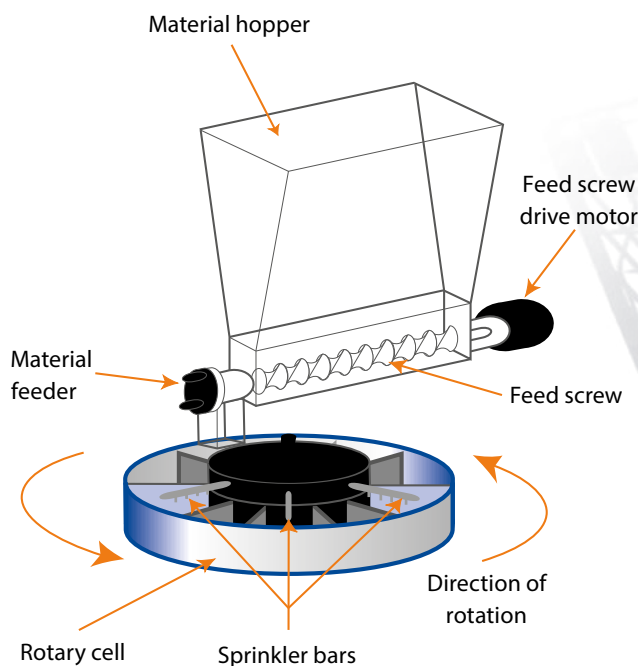


## The Armfield UOP4-MKII - Laboratory-Scale Solid/Liquid Extractor System

The equipment utilises a sophisticated, continuous feed, counter-current flow, multiple-stage, rotary extractor system of the type frequently seen in industrial applications. This gives the student an insight into the practical implementation of the operation, including process economics and control problems.

### Experimental Capabilities:

- ▶ Demonstration of the operation of a continuous multiple-stage process
- ▶ Closed-circuit percolation extraction (batch extraction)
- ▶ Open-loop percolation extraction (continuous operation)
- ▶ Investigation of continuous extraction in 1, 2 or 3 steps
- ▶ Investigation into effect of solvent temperatures
- ▶ Investigation into effect of solvent flow rates
- ▶ Investigation into effect of processing time
- ▶ Process economics
- ▶ Mass balances



### Requirements

- 1Ph
- PC
- USB
- COLD

### Solid-Liquid Extraction Unit - UOP4-MKII

The Armfield unit is designed to demonstrate a simplified version of the moving-bed leaching process used by many industrial solid/liquid extraction systems.

The process used is a continuous multi-stage process, which gives counter current flow of the solvent and the solid phase.

A batch extraction vessel is also incorporated to allow demonstration of fixed-bed leaching with either open or closed loop circulation of the solvent.

The effects of temperature, throughput rate and the effect multiple stages can all be investigated.



Software  
inc

## Unit Operations - UOP Series

### The Armfield UOP5-MKII - Liquid-Liquid Extraction Unit

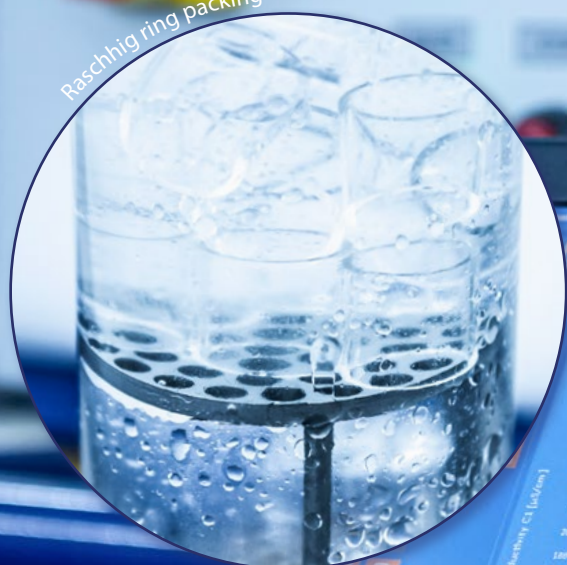
Liquid/liquid extraction is an important operation in chemical engineering where the separation of one or more of the components from a liquid mixture is required. Traditionally this has been difficult to demonstrate in the laboratory, requiring the use of highly toxic, expensive and/or environmentally damaging solvents.

The Armfield UOP5-MKII introduces a system using 1-Octanol or Canola oil which are safe, readily available and inexpensive.

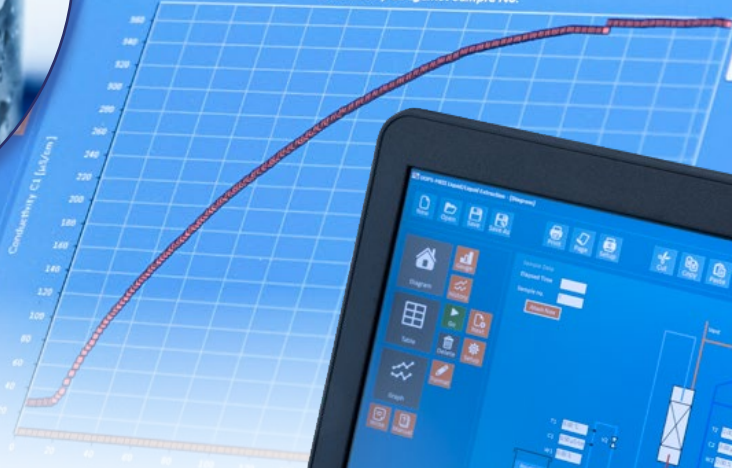
#### Experimental Capabilities:

- ▶ Hydrodynamics of a packed liquid/liquid extraction column
- ▶ Differences in extraction performance using the organic phase or the aqueous phase as the continuous phase
- ▶ Investigation into the effect of changes in aqueous and organic flow rate
- ▶ Mass balances and the calculation of mass transfer coefficient
- ▶ Mass balances

Raschig ring packing



Conductivity CI against Sample No.



Mimic software screen supplied with UOP5-MKII

#### Liquid-Liquid Extraction Unit - UOP5-MKII

This unit provides an introduction to the operation of an industrial type of liquid/liquid extraction system.

A vertical column is used to contact two essentially immiscible liquids flowing counter-currently through Raschig ring packing. Either liquid can be selected to be the continuous phase.

Traditionally this has been difficult to demonstrate in the laboratory, requiring the use of highly toxic, expensive and / or environmentally damaging solvents.

The Armfield UOP5-MKII introduces a system using Kerosene (Paraffin) which is simple, safe and inexpensive.

Option: **AC1** (Air compressor)

#### Requirements

1Ph

PC

USB

COLD

COMP.

AIR





## The Armfield UOP7-MKII - Gas Absorption Column

The Armfield Gas Absorption Column has been designed to demonstrate the principles of gas absorption and to provide practical training in the operation of a gas absorption plant.

In the process of gas absorption, a mixture of gases is contacted with a liquid, for the purpose of dissolving one or more components of the gas and to provide a solution of them into the liquid.

Raschig ring packing



### Experimental Capabilities:

- ▶ Study of basic principles of the absorption of a gas into a liquid using a packed column
- ▶ Determination of loading and flooding points
- ▶ Study of hydrodynamic characteristics of a packed column
- ▶ Demonstration of physical and chemical absorption
- ▶ Investigation of the effectiveness of CO<sub>2</sub> absorption in pure water and in an aqueous solution
- ▶ Demonstration of gas desorption
- ▶ Determination of the mass transfer coefficient



Mimic software screen supplied with UOP7-MKII

### Requirements

#### Gas Absorption Column - UOP7-MKII

1Ph

PC

USB

COLD

CO<sub>2</sub>

A pilot-scale apparatus enabling familiarity with the characteristics of packed tower hydrodynamics and absorption processes.

The gas absorption column has been designed to demonstrate the process of gas absorption, desorption and stripping.

The Absorption Column is scaled so that teaching exercises can be completed in a typical laboratory class period, while at the same time capable of demonstrating full-scale plant behaviour.

The system is supplied as standard with electronic control of fluid flow, electronic measurement of CO<sub>2</sub> concentration and full computer control and data logging.



Software inc



Software inc

### Modular Evaporator Series - UOP20X (STM or PHW)

Maximum flexibility of choice and specification results from the modular approach, which offers a wide number of configurations.

The service unit is capable of housing one or two columns with rising or falling film evaporation and controlled recirculation in either position. High vacuum capability enables low temperature evaporation.

Integral pressurised hot water heating or external steam supply options are also available.

Full computer compatibility is provided and educational software is included detailing the equipment, evaporation theory, logging and analysis of results, questions and answers and a workbook facility.

If it is required to operate the system from an external steam supply, Armfield can provide a laboratory steam generator (UOP10) with a heat output of 30KW.

**Rising film evaporator column (1st effect, 1st position)-UOP22-11**

**Rising film evaporator column (2nd effect, 2nd position)-UOP22-22**

**Falling film evaporator column (1st effect, 1st position)-UOP23-11**

**Falling film evaporator column (2nd effect, 2nd position)-UOP23-22**

**Falling film evaporator column (1st effect, 2nd position)-UOP23-12**

#### Requirements



Software inc

### Rising Film Evaporator - FT22 (Data Logging Included)

A floor-standing unit using the steam-heated, climbing film principle to concentrate small quantities of liquid foods, either continuously or in batches.

The important process parameters can be varied and monitored.

The rising film evaporator consists of a vertical tube within a shell. Steam in the shell increases the temperature of product entering the tube at the base.

As product boils, vapour rises up the tube, carrying a film of concentrated liquor up the inside walls of the tube. At the top of the tube the vapour is separated from the liquor in a cyclone separator and the vapour is then condensed.

#### Concentration of:

- ▶ Juices (fruit and vegetable)
- ▶ Milk and milk products
- ▶ Extracts (non-flammable)
- ▶ Effluents
- ▶ Nutritional products

#### Features & Benefits:

- ▶ Small quantities of liquid products can be concentrated
- ▶ Easily cleaned and maintained
- ▶ Low product usage eases the disposal of waste
- ▶ Nominal throughput only 10 l/hr
- ▶ Single tube heat exchanger
- ▶ Integral CIP system
- ▶ Integral control console
- ▶ Integrated data logging and analysis

#### Requirements





## Requirements

- 3Ph
- PC
- USB
- COLD
- COMP. AIR

### Filtration Unit - UOP12

The Filtration Unit has been designed to demonstrate the application of Darcy's Law of Filtration.

The unit is equipped with a fully functional Plate and Frame filter unit, the most commonly used dead end, batch filter design. As an option, a continuous, tangential flow filter is available which uses an industry standard, hollow fibre cartridge system.

In the case of batch filtration, measurement of operating pressure, volumetric flow rate and optical absorbance enables, cake and medium filtration resistances, benefits of filter aid, mass balancing and washing regimes to be investigated.

For tangential flow filtration, similar measurements enable membrane flux and transmission relationships and washing regimes to be examined.

The plate and frame filter press can be readily switched for the hollow fibre, tangential flow unit enabling both methods of filtration to be investigated in a short period of time.

#### Tangential Flow Filter Accessory - UOP12-10 Option: AC1 (Air compressor)



Software Inc

## Requirements

- 1Ph
- PC
- USB
- COLD

### Crystallisation Unit - UOP14-MKII

The Crystallisation Unit is a teaching unit which demonstrates the principles of crystallisation using batch cooling crystallisation. The system may also be used in a continuous mode when used with the Armfield Crystallisation Feed Unit UOP14-11. It is possible to run two basic modes of operation using the following units:

#### Batch operation - UOP14-MKII only

#### Continuous operation - UOP14-MKII with UOP14-11

Crystallisation takes place inside a jacketed vessel with a stirrer and baffle. The temperature of the crystallisation reaction is varied by changing the temperature of water circulated through the jacket. Heating to dissolve the crystals is affected by passing the hot water from the hot water vessel into the jacket whilst cooling is achieved using the mains cold water supply directly without heating. Alternatively, a chilled water supply (CW-17) may be necessary if the local cold-water supply is not sufficiently cold to form crystals in the saturated solution.

The unit is supplied with PC software and incorporates a USB computer interface to allow on-line control and monitoring as well as data logging.

The optional Armfield continuous Crystallisation Feed Unit UOP14-11 is totally self-contained and consists of a feed tank with PID controlled heater and a peristaltic pump. This option can be added at any time to turn the UOP14-MKII Batch Crystalliser into a continuous system.

An optional Buchner vacuum filtration system (UOP14-12) can be used to remove crystals suspended in the solution.

#### Available accessories:

- Continuous Feed Accessory - UOP14-11
- Buchner Filtration Accessory - UOP14-12
- Chilled Water Circulating Unit - CW-17



Software Inc

## Computer Controlled Tray Dryer - UOP8-MKIIe

Requirements

The most commonly used industrial method of drying solids in bulk consists of passing a hot air stream over fixed trays of wet material.

This small pilot-scale tray dryer uses this method and is designed for laboratory training programmes. Operating conditions may be varied in a way that provides data demonstrating both theoretical and practical aspects of industrial drying practice.

This equipment is applicable to the unit operations laboratory and also to food technology education and research.

- 1Ph
- PC
- USB



Software inc



## 3-Phase Horizontal Separator - UOP30

Requirements

The Armfield 3-Phase Horizontal Separator is a small-scale unit capable of demonstrating the principles and operation of gravity separation and the effect of viscosity, flow characteristics and density difference on separation.

The UOP30 comes with two horizontal separator configurations interface/weir and bucket/weir making the UOP30 a versatile teaching unit.

The separation of two immiscible liquids and a gas using density difference is one of the most important process operations in the oil and gas industry.

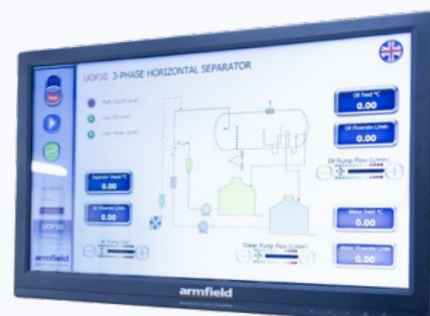
Examples include separation of produced water and condensate from gas and the separation of gas and produced water from crude oil.

**UOP30 armBUS-LCD-15.6 Touchscreen (Optional)**

- 1Ph
- PC
- USB
- COLD
- OIL



Software inc





## Requirements

### Fixed Bed Adsorption Unit - UOP15

1Ph

PC

USB

HE

CO<sub>2</sub>

The unit demonstrates the adsorption of a solute, carbon dioxide, from a binary gas mixture onto the surface of a solid adsorbent, activated carbon.

The adsorption and desorption/regeneration processes take place in a fixed bed adsorption column.

#### Educational Content:

- ▶ To study the absorption of the CO<sub>2</sub> in a packed column containing activated carbon.



## Requirements

### Spray Dryer - FT30-MKIII

1Ph

COMP.  
AIR

A simple and effective laboratory scale spray dryer for product research and development. The spray dryer is designed to enable initial product trials and evaluation to be carried out quickly and efficiently.

The unit is supplied with a complete set of glassware comprising of main drying chamber, cyclone, sample collection and waste collection bottles, clamps, seals and all necessary tubing.

The chemically resistant housing includes the blower, heater and the controls for inlet temperature and pump speed. The drying air volume is fixed at 70m<sup>3</sup>/hr.

**AC1 - Air compressor (Optional)**



## Requirements

### Basic Water Cooling Tower - UOP6-MKII

1Ph

PC

USB

This basic water cooling tower has been specifically designed to give students an appreciation of the construction, design and operational characteristics of a modern forced draught evaporative cooling system.

The unit is also an excellent example of an open system through which two streams of fluid (water and air) flow in counter-current directions, with heat and mass transfer from one stream to the other.

The system is supplied as standard 1/3 height and 2/3 height packing in addition to full height packing for comparison.

The tower is fully instrumented with electronic sensors and is operated and controlled via a USB port on a PC.

**UOP6-MKII-23 Packing Characteristics accessory (Optional)**





# Biochemical Engineering

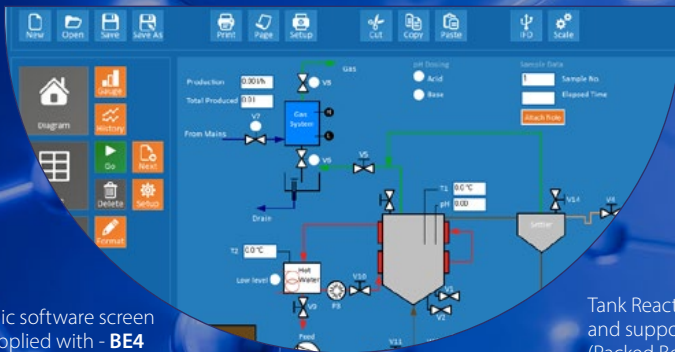


Biochemical Engineering is currently a growth area, attracting worldwide interest. Although many of the techniques and operations are common with Chemical Engineering, there are some important differences.

The BE series has four core products:

- ▶ BE1 Batch Enzyme Reactor
- ▶ BE2 Chromatography Unit
- ▶ BE3 Anaerobic Column Reactor
- ▶ BE4 Anaerobic Tank Reactor

Which together with CEU Catalytic Reactors from the CE series (pages 70-73), give students an introduction and understanding of important Biochemical Engineering principles.



Mimic software screen supplied with - BE4

Tank Reactor showing detail of bio-balls and supports, configured as PBR (Packed Bed Reactor)



## Anaerobic Tank Reactor - BE4

A self-contained, floor-standing anaerobic tank reactor, volume 20 litres, stirrer, motor and baffles are removable for non-stirred configurations.

- ▶ A self-contained, floor-standing anaerobic tank reactor, volume 20 litres
- ▶ Continuous stirred tank reactor (CSTR)
- ▶ Packed bed reactor (PBR)
  - ▶ Upflow anaerobic sludge blanket reactor (UASB)
  - ▶ Measures reactor temperature, jacket temperature and vessel pH
  - ▶ Programmable logic controller (PLC) provides temperature control, pH control and gas collection (rate and totalisation) calculations
  - ▶ Jacket heating system with pump and hot water vessel. Temperature is PID controlled room temperature to 55°C
- ▶ Automated volumetric gas collection system measures, which adds less than 10 mbar back pressure to the reactor
- ▶ Complete with automated pH dosing system to maintain the vessel pH within a predetermined range (user programmable)
- ▶ User calibration of pH and gas collection system
- ▶ Feed flow rates from 0.06-4.8 l/hr (using interchangeable peristaltic hoses)
- ▶ Gas sample point
- ▶ Data logger and software as standard (requires PC, not supplied)
- ▶ Stirrer, motor and baffles are removable for non-stirred configurations
- ▶ Variable depth liquid sampling point

## Settling Reactor Tank BE4-1 (Optional)

An optional settler (BE4-1) is also available for the Anaerobic Tank Reactor BE4. Its function is to collect solid particles of biomass at the exit from the reactor for return to the reactor in the BE4. This biomass would otherwise be lost to the system.

### Requirements

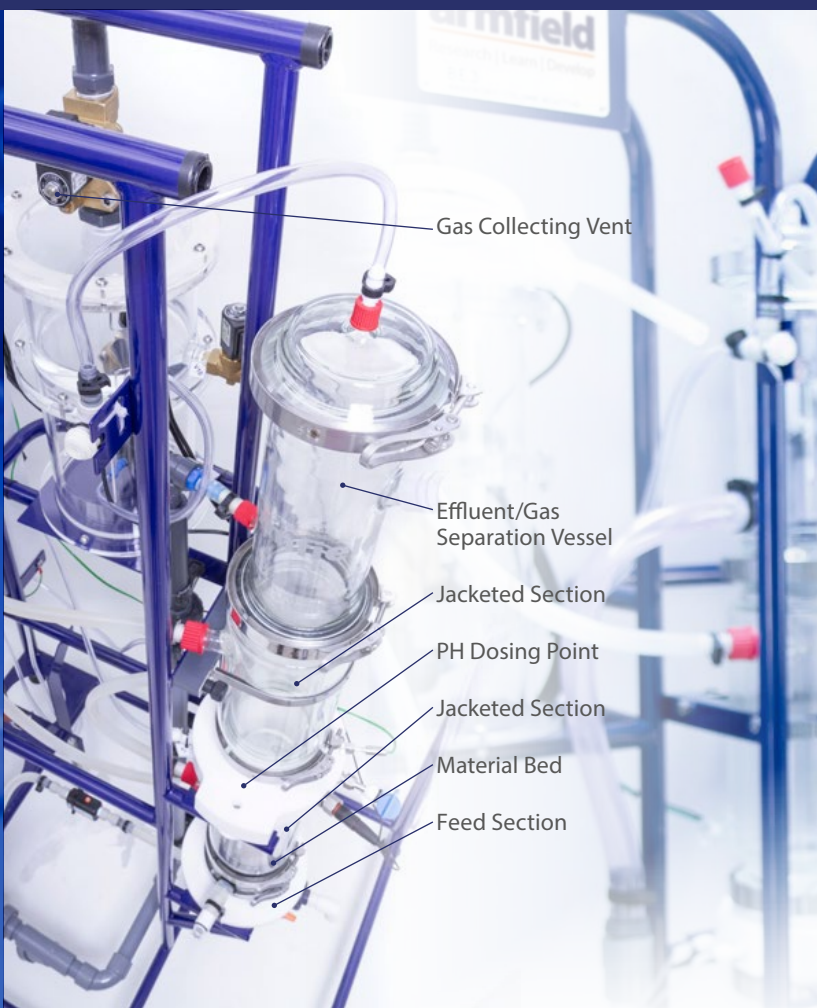
- 1Ph
- PC
- USB
- COLD
- EXTRACTOR





## BE3 - Anaerobic Column Reactor Experimental Capabilities

- ▶ Optimising reactor start-up (acclimation of biomass)
- ▶ Effect of temperature, pH, residence time etc.
- ▶ Investigation of hydraulic loading (feed rate)
- ▶ Effect of effluent strength and nutrient deficiency
- ▶ Effect of recirculation ratio and fluidisation
- ▶ Comparing efficiency of different configurations (BE4)
- ▶ Investigation of bacteria type
- ▶ Acidogenesis and methanogenesis process demonstrations



### Requirements

### Anaerobic Column Reactor - BE3

A self-contained, floor-standing anaerobic column reactor of a 9l volume. It is configurable as a fluidised bed reactor and an expanded granular sludge bed reactor (EGSB). Incorporating a split heated column with central collar for instrumentation, dosing and liquid sampling. It has a recycle pump capable of rates from 0-15 l/min and an electronic measurement of recycle rate.

- ▶ Fluidised bed
- ▶ Expanded granular sludge bed reactor (EGSB)
- ▶ Measures reactor temperature, jacket temperature and vessel pH
- ▶ Programmable logic controller (PLC) provides temperature control, pH control and gas collection (rate and totalisation) calculations
- ▶ Jacket heating system with pump and hot water vessel. Temperature is PID controlled room temperature to 55°C
- ▶ Automated volumetric gas collection system measures, which adds less than 10 mbar back pressure to the reactor
- ▶ Complete with automated pH dosing system to maintain the vessel pH within a predetermined range (user programmable)
- ▶ User calibration of pH and gas collection system
- ▶ Feed flow rates from 0.06-4.8 l/hr (using interchangeable peristaltic hoses)
- ▶ Gas sample point
- ▶ Data logger and software as standard (requires PC, not supplied)
- ▶ A self-contained, floor-standing anaerobic column reactor, 9l volume
- ▶ Configurable as a fluidised bed reactor and an expanded granular sludge bed reactor (EGSB)
- ▶ Split heated column with central collar for instrumentation, dosing and liquid sampling
- ▶ Recycle pump capable of rates from 0-15 l/min
- ▶ Electronic measurement of recycle rate



- 1Ph
- PC
- USB
- COLD
- EXTRACTOR



Software inc

Software  
inc



## Batch Enzyme Reactor - BE1

A batch enzyme reaction system that utilises the industrially important glucose isomerisation reaction (converting glucose to fructose) catalysed by glucose isomerase.

The purpose of the unit is to demonstrate batch enzyme kinetics and enzyme characteristics.

The reaction takes place inside a stirred vessel where the stirrer itself is a porous basket inside which the enzyme is immobilised.

A polarimeter device, which is integral to the unit, monitors the glucose and fructose concentrations with time.

### Requirements

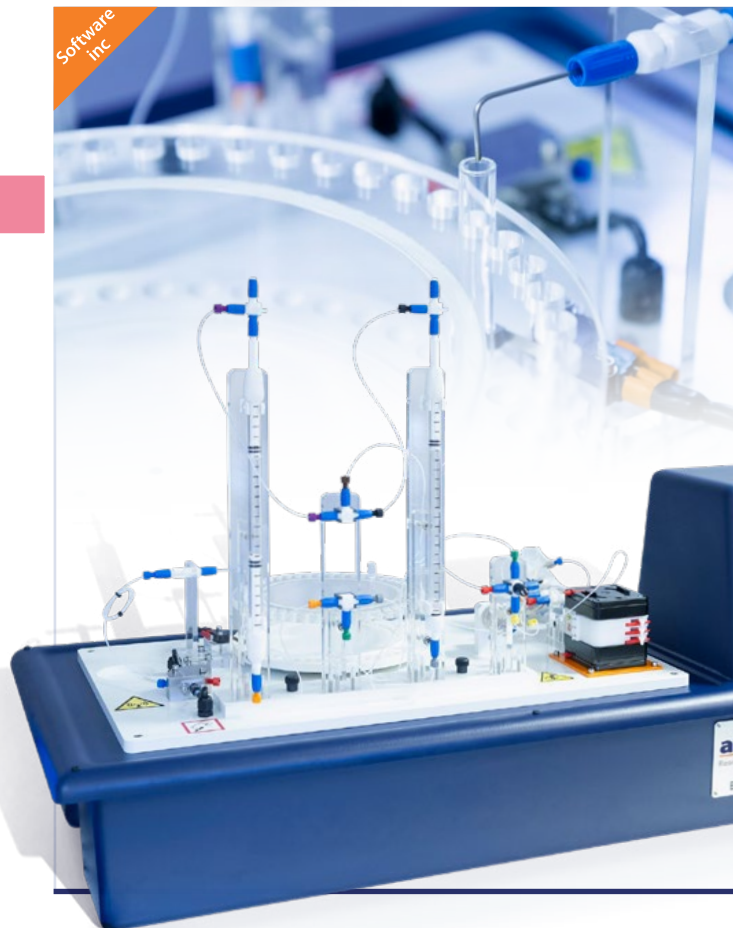
1Ph

PC

USB



Software  
inc



## Chromatography Unit - BE2

Used to demonstrate the principles and practices of chromatography - an important operation for both small-scale analysis and large-scale production of biologics. BE2 features two chromatography columns of variable bed height, which are fed by a peristaltic pump.

An injection point enables samples to be introduced onto the column.

The unit has an on-line UV sensor for measuring protein concentration as it exits the column. The unit is also equipped with a timer-controlled fraction collector. Size exclusion chromatography is the primary separation technique used for the demonstrations.

Engineering principles, such as the effect of feed flow rate and bed height on process performance can be investigated.

Option:

**Filtration/Degassing Assembly - BE2-1**

### Requirements

1Ph

PC

USB





Link to remote access



# Computer Control & Remote Access

## Computer control is so much more than just datalogging a sensor!

Armfield's range of computer-controlled products, provide not only real time monitoring and datalogging, but additional computer control of multiple variables used when undertaking experimentation

This control is already available for remote access and distance learning in many Armfield products

### Remotely enabling Armfield products

- ▶ Using standard IT equipment, such as a laptop or computer, it is relatively straight forward to extend the connectivity of the Armfield software to a remote location
- ▶ Distance learning is achieved by utilising TeamViewer, Microsoft teams or an alternative 3rd party collaboration software which allows the end user to take control of the local PC
- ▶ Using standard, IT hardware such as web camera's remote users can clearly see individual elements of the Armfield equipment, the only limitation to the number of cameras installed is the number of supported USB ports on the local PC/Laptop. Utilising standard USB Hubs can extend the number of USB devices if there is a hardware limitation on the local PC/Laptop
- ▶ The standard windows camera application is used to view the web camera feeds
- ▶ The collaboration software extends the capability of our existing software from a 1-to-1 local connection to 1-to-many network connections. **(The key benefit here would be to allow enhanced social distancing in a local environment with multiple local users able to view the Armfield software)**
- ▶ The onus is on the end user to install and provide support for any 3rd party collaborative software. Although Armfield can offer this as a chargeable professional service



**PCT**  
SERIES

# Process Control Technology



**A range of process teaching equipment is available to demonstrate relevant measurement and control experiments using real engineering equipment.**

The Armfield PCT range is designed on a building-block approach, which ensures that experimental set-ups can be assembled economically to meet individual course requirements.

Each practical work study system consists of a benchtop process demonstration unit and a control console, which contains the power supplies and interfacing for all measurement and actuation signals. Industrial controllers are available as accessories to further develop the practical instruction courses possible.

Additionally, the Essentials of Process Control (EPC) range of products takes students through the fundamentals and principles of process control, and progresses to give them a thorough grounding in the control of physical processes. Four independent process units demonstrate level, flow, temperature and pressure as the controlled variable.



The Process Plant Trainer incorporates an electrical console which provides access to the various signals associated with measurement and control of the process allowing a variety of control possibilities



Advanced educational software package included, which implements the control functions.

## Process Plant Trainer - PCT23-MKII

The Process Plant Trainer can be used to demonstrate a complete range of process control methods and strategies.

Manual control, single feedback loops, through to sophisticated cascade loops and distributed supervisory control of the whole process by a remotely located computer can be demonstrated.

The system is a miniature replication of a true production process. The student is presented with real process control problems, with realistic dynamic behaviour and instabilities.

### Requirements

PC

1Ph

USB

COLD



Software inc





## Requirements

### Multi-Function Process Control Teaching System - PCT40

PC

1Ph

USB

COLD



The Armfield system is designed for use in teaching a wide range of process control methods. The PCT40 basic unit is used under computer control to demonstrate a variety of process control loops.

Processes such as level control, temperature control, flow control and pressure control can all be investigated, as can manual, on/off, proportional and PID control. The software included with the unit allows the student to change the control parameters and analyse the results from different configurations.

More advanced aspects of control can be addressed by adding optional extras to the basic system.



Software  
Inc

## Requirements

### Process Vessel Accessory - PCT41

PCT  
40



The process vessel expands on the capabilities of the PCT40 with a wider range of control loops and strategies, including remote set points, dual loops and fluid property control (using conductivity as a representative example).

All these loops are under software control. It includes a stirrer with electric motor, as well as a second heating coil. It includes provision for the pH probe accessory PCT42 (Optional)



Software  
Inc

## Requirements

### pH Sensor Accessory- PCT42

PCT  
40

PCT  
41



This conductivity probe can be used to demonstrate fluid property control systems, without the maintenance problems which can be experienced with pH probes.

However, as pH control is probably the most common industrial application of this type of control system, users may wish to implement true pH control loops.

This can easily be implemented by adding the PCT42 pH sensor accessory to the combined PCT40 + PCT41 system.



Software  
Inc

## Requirements

### Electronic Control Console - PCT43

PCT  
40

PCT  
41

1Ph



The PCT43 is an electronic control console that can be used to control the PCT40, PCT41 and PCT42 instead of a computer. It includes controls for the pumps, valves and heater, plus a display for the sensors.

It incorporates a commercial PID controller, complete with RS232 interface. Other facilities include 4-20mA interfaces and selector switches to enable many of the different configurations to be implemented without using external jumper connections.



## Requirements

### Pneumatic Valve Module Accessory - PCT44

PCT  
40

PCT  
41

COMP.  
AIR



The unit is a pneumatic control valve, plus associated components, for use with the PCT40/PCT41 system.

Retaining the flexible concept of the whole range, it can be plumbed into many of the flow control loops, and provides a good illustration of pneumatic valve technology.

**AC1** - Air compressor (Optional)



Software  
Inc

# Process Control Technology - PCT Series

Software inc



## EPC Level Control - PCT50

The Essentials of Process Control (EPC) range of products takes students through the fundamentals and principles of process control and progresses to give them a thorough grounding in the control of physical processes.

The PCT50 is a highly visible and easy to understand water level control process.

It comprises two clear acrylic tanks; a process tank mounted above a sump tank. Water is pumped up to the process tank and drains back to the sump tank via two valves, one manually variable and the other switched by software.



Requirements

- PC
- 1Ph
- USB
- COLD



Software inc



## EPC Flow Control - PCT51

The unit is a visible and easy to understand water flow control process.

Water stored in the sump tank is pumped through a parallel pipe arrangement mounted on the lid of the tank and returns to the tank via two outlets, a software switched divert valve prior to the flow meter and a manually operated variable valve after the flow meter.



Requirements

- PC
- 1Ph
- USB
- COLD



Software inc



## EPC Temperature Control - PCT52

The unit is a visible and easy to understand temperature control process.

A fan blows air over a heater with radial fins and through a vertical clear acrylic duct. Sensors measure the surface temperature of the heater and the air temperature in the duct.



Requirements

- PC
- 1Ph
- USB





## Requirements

### EPC Pressure Control - PCT53

PC

1Ph

USB



This highly visible and easy to understand pressure control process unit uses pumped water to generate air pressure in a closed tank.

It comprises two clear acrylic vessels; an upper process vessel mounted above an open sump tank. The process vessel is sealed and so the air inside the tank is pressurised as water from the sump tank is pumped into it.

Water drains from the process tank back into the lower sump tank via two outlets, one continuous and one incorporating a remotely controlled solenoid valve. Both outlets incorporate interchangeable orifices plus a hand operated variable valve, allowing the flow of water to be varied continuously to suit particular demonstrations.



## Requirements

### EPC Industrial PID Controller - PCT54

1Ph



The unit is an industrial PID controller incorporated in a console with input and output connections and controls on the front panel, designed primarily for use with the Armfield EPC series of process control products. **Suitable for use as a general purpose PID controller.**



## Requirements

### EPC Programmable Logic Controller - PCT55

1Ph



The unit is a programmable logic controller (PLC) with a graphical touchscreen control panel designed primarily for use with the Armfield EPC series of process control products, but can also be used to control other items.

It is supplied with PID control algorithms implemented in ladder logic and configured to suit each of the EPC processes.



## Requirements

### EPC Sensor Conditioning and Calibration Trainer - PCT56

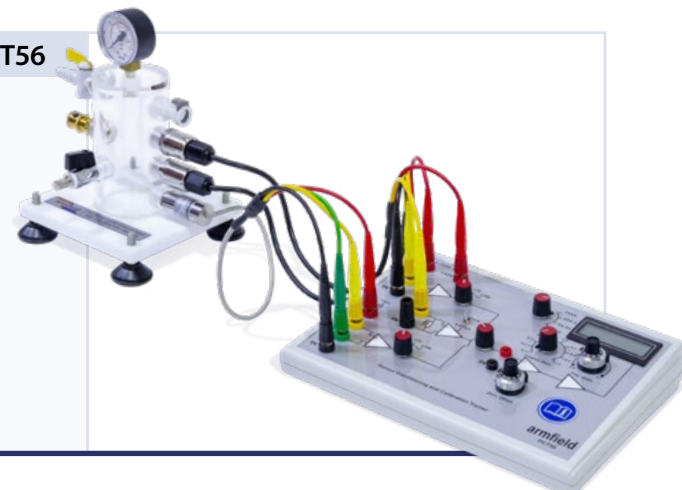
1Ph



The unit is a trainer designed to introduce the essentials of signal conditioning applicable to process measurement sensors.

It comprises an electronic console with inputs for sensors with three different types of electrical output, voltage current and resistance.

The resistance input can be configured as a two-terminal or four-terminal bridge drive.





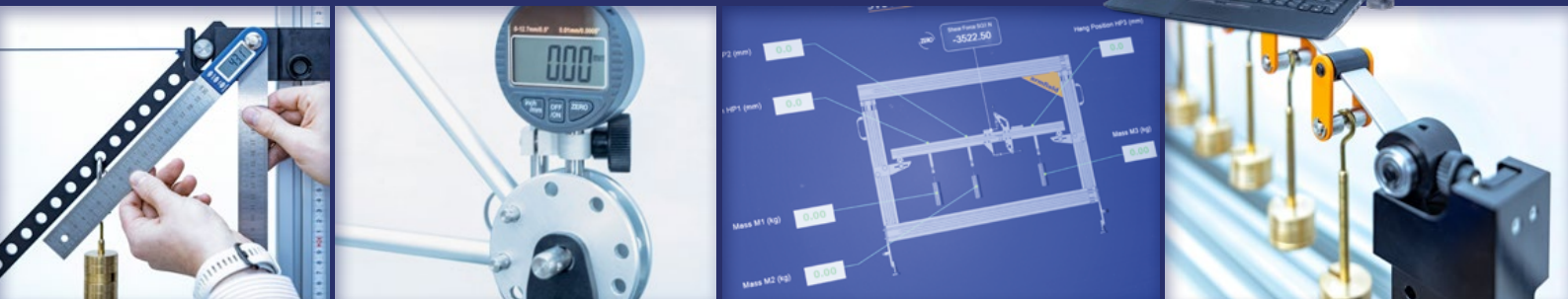
# Structures



A range of experiment frameworks that teach the principles of structures for Mechanical, Civil, and Structural Engineering. This allows the experimental investigation into Forces in a Truss, Strength of Materials, Forces & Moments, Bridges, Beams, Arches, Cables, Torsion & Buckling.



The experiments are easily attached to the frame with secure fixings. Weights in excess of 500 N can be applied safely



The Armfield SV structures range consists of a modular, highly stable frame-based range of teaching equipment for covering all the major principles of structural engineering. Covering topics such as forces in a truss, strength of materials, forces, moments, bridges, beams, arches cables, bulking and torsion.

*The complete range consists of 23 individual kits and is supplied with armBUS software as standard.*

## Forces in a Truss

- ▶ SV200 - Pin Jointed Frameworks (Roof and Warren Truss)
- ▶ SV201 - Forces in a Truss and Redundant Truss
- ▶ SV202 - Deflection of Trusses

## Bridges, Beams, Arches & Cables

- ▶ SV300 - Combined Shear Force and Bending Moment Apparatus
- ▶ SV301 - Shear Force in a Beam
- ▶ SV302 - Bending Moments in a Beam
- ▶ SV303 - Deflection of Beams and Cantilevers
- ▶ SV304 - Equilibrium of Forces
- ▶ SV305 - Suspension Cable
- ▶ SV306 - Bending Stress in a Beam

## Forces & Moments

- ▶ SV400 - Simple Suspension Bridge
- ▶ SV401 - Deflection of a Frame
- ▶ SV402 - Suspended Centre Span Bridge
- ▶ SV403 - Three-Pinned Arch
- ▶ SV404 - Two-Pinned Arch
- ▶ SV405 - Semi Circular Arch

## Strength of Materials

- ▶ SV500 - Continuous and Indeterminate Beams
- ▶ SV501 - Plastic Bending of Beams
- ▶ SV502 - Plastic Bending of Portals
- ▶ SV503 - Deflection of Curved Bars

## Torsion and Buckling

- ▶ SV600 - Buckling of Struts
- ▶ SV601 - Unsymmetrical Bending and Shear
- ▶ SV602 - Torsion of Rods and Tubes



# Structures Interface Unit (SV101)



The Armfield SV101 is a compact interface unit for the Armfield Structures range which can be placed in a convenient position beside the test equipment.

The unit provides direct integration between a compatible structures experiment and the Armfield armBUS software. Connection to the users computer is made through the front mounted USB socket.

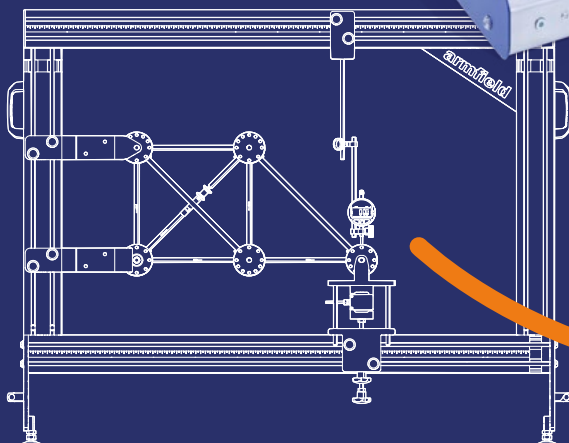
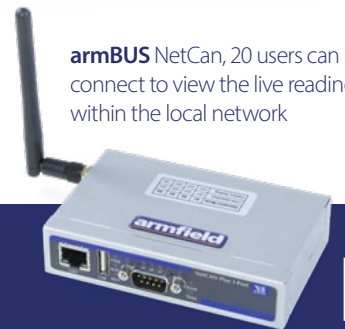
On the clearly defined front panel there are thirteen sockets for connecting strain-gauges, three sockets for connecting 5.4kg load cells and two sockets for connecting 100kg load cells.

If required, the number of strain-gauge and load cell sockets can be doubled by joining two SV101 consoles via the armBUS Multi Channel (ABMC) connection.

SV101 - Structures Interface Unit

armBUS NetCan, 20 users can connect to view the live readings within the local network

## Connection to computer



Sensors on the connecting rods send load information to your computer via the Armfield Structures Interface Unit.

Automatically updating tables in real time, as you add load to the structure.

Armfield Structures Interface Unit (SV101)



PC or laptop



Choose your experiment in the Armfield software

Armfield Bench Mounted Frame (SV100)



## Bench Mounted Frame – SV100

Requirements

A lightweight aluminium bench mounted frame that enables quick and easy attachment of the interchangeable experiment modules from the Armfield SV Structures range.

The frame is supplied with a fixing system that has been designed to be quick and easy to use. It allows students to change, position and secure each experiment.

Adjustable feet support the frame to allow students to level the apparatus before use.

The experiments are easily attached to the frame with secure fixings. Loads in excess of 50kg can be applied safely.



## Structures Interface Unit – SV101

Requirements

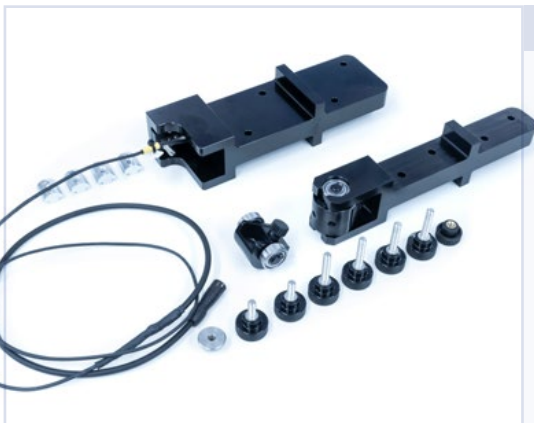
The Armfield SV101 is a compact interface unit for the Armfield Structures range which can be placed in a convenient position beside the test equipment.

The unit provides direct integration between a compatible structures experiment and the Armfield armBUS software.

Features:

- ▶ 2 x 100kg Load Cell Ports
- ▶ 13 x Strain Gauge Ports
- ▶ 3 x 5.4kg Load Cell Ports

1Ph  
SV  
100



## Pinned Support Kit - SV102

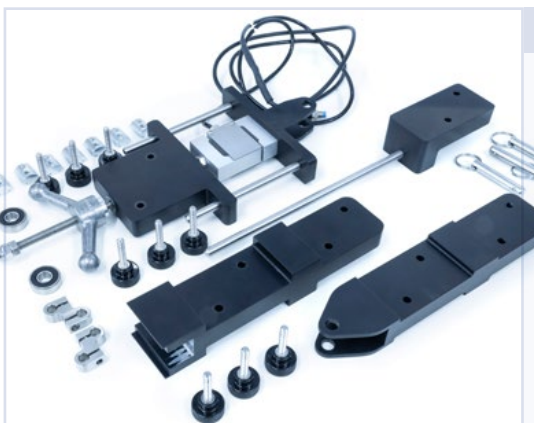
Requirements

This kit is required for four SV400 series kits.

The kit has the following components:

- ▶ Pivoting Support Assembly to act as a pinned support
- ▶ Horizontal Reaction Force Support Assembly which simulates a sliding support to measure horizontal thrust on arches and beams (up to 5.4kg)
- ▶ Frame connecting hardware

1Ph  
SV  
100



## Frame Mounting Kit – SV103

Requirements

This kit is a requirement for all SV200 series truss frameworks.

The kit has the following components:

- ▶ Two supports - a pinned support and sliding support to hold the truss frameworks in position on the Bench Mounted Frame
- ▶ A load application assembly - capable of applying loads up to 100kg to the truss frameworks
- ▶ A DTI and DTI holder assembly to measure vertical deflection of truss frameworks under load
- ▶ Truss framework connecting hardware

1Ph  
SV  
100





## Forces in a Truss

## Requirements

**Pin-Jointed Frameworks (Roof and Warren Truss) – SV200**

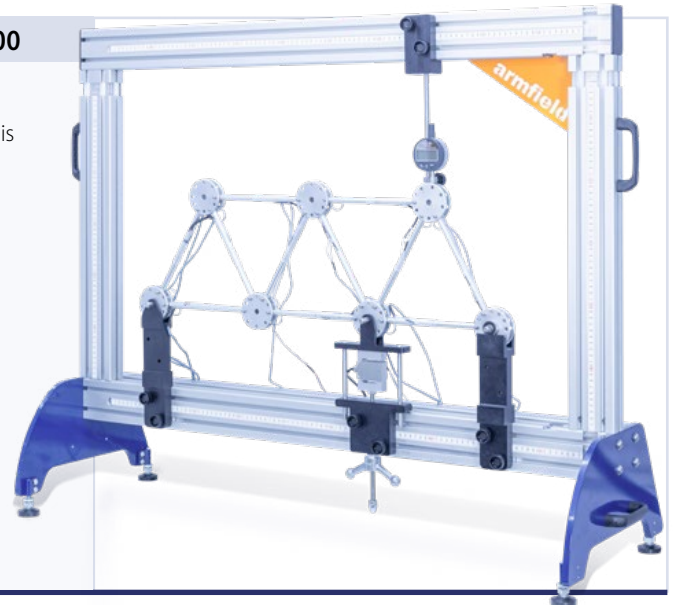
1Ph

SV  
100SV101  
InterfaceSV103  
Mounting  
Kit

The Pin-Jointed Frameworks experiment is intended for use with the Armfield Universal Bench Mounted Frame and allows the experimental investigation of deflection of trusses under load. This then allows Castigliano theorems to be proven.

The experimental content has the following properties:

- ▶ Assembly of both a basic Roof and Warren Truss via various length members, detent pins and joint hubs
- ▶ Up to 10 members possible in one joint hub
- ▶ Members suitable for use with both trusses



## Requirements

**Forces in a Truss and Redundant Truss – SV201**

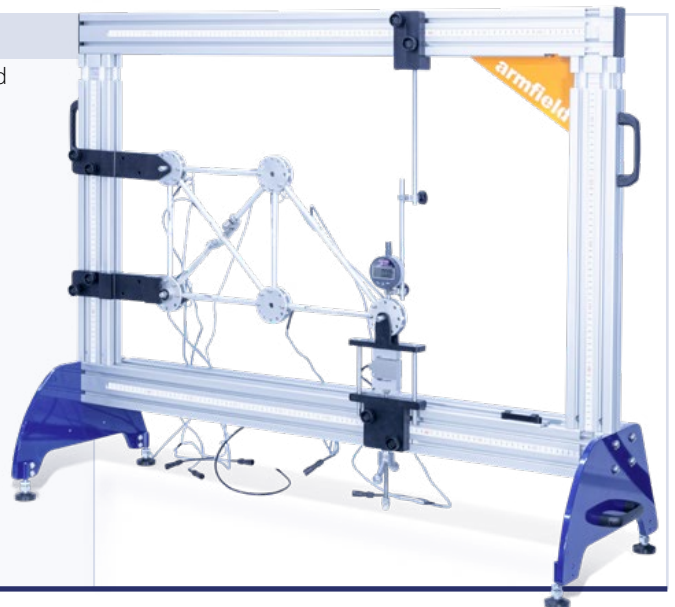
1Ph

SV  
100SV101  
InterfaceSV103  
Mounting  
Kit

The Forces in a Truss and Redundant Truss experiment is intended for use with the Armfield Universal Bench Mounted Frame and enables the experimental investigation of deflection of trusses under load. This then allows Castigliano theorems to be proven.

The experimental content has the following properties:

- ▶ Assembly of both a determinate and indeterminate truss framework via various length members, detent pins and joint hubs
- ▶ Quick and easy assembly of members via detent pins and joint hubs
- ▶ Up to 10 members possible in one joint hub
- ▶ Loading unit with spindle drive and universal load cell for force measurement
- ▶ Members suitable for use with both trusses



## Requirements

**Deflection of Trusses – SV202**

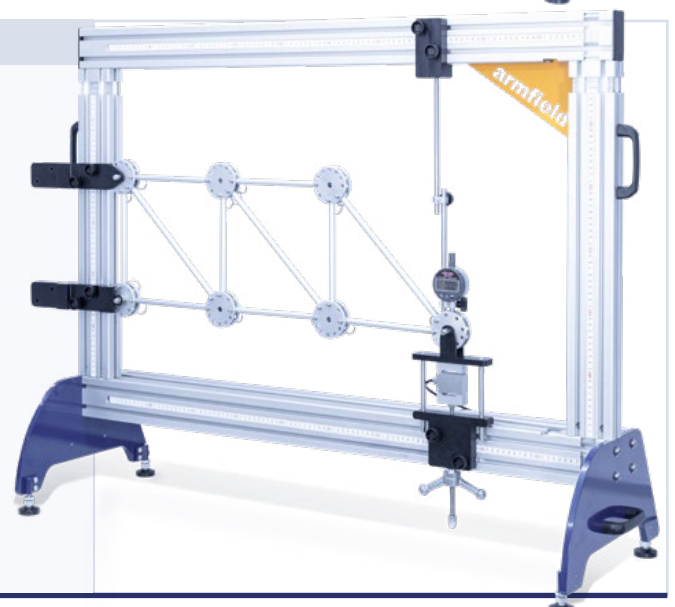
1Ph

SV  
100SV101  
InterfaceSV103  
Mounting  
Kit

The Deflection of Trusses experiments allows the experimental investigation of deflection in trusses under load. This then allows Castigliano theorems to be proven.

The experimental content has the following properties:

- ▶ Assembly of three 3-bay trusses via various length members, detent pins and joint hubs
- ▶ Up to 10 members possible in one joint hub
- ▶ Common members between all three trusses
- ▶ Digital indicator used to measure frame deflection



## Bridges, Beams, Arches and Cables



### Combined Shear Force and Bending Moment Apparatus – SV300

The Shear Force and Bending Moment in a beam allows the experimental investigation of the internal shear force and bending moment of a simply supported beam under different point loads.

The experimental content has the following properties:

- ▶ Split beam allows the internal shear force and bending moment at the split to be measured
- ▶ Up to 3kg of point loads can be applied to the beam across three movable weight hangers
- ▶ Adjustable simple supports

Requirements

1Ph  
SV  
100  
SV101  
Interface



### Shear Force in a Beam – SV301

The Shear Force in a Beam allows the experimental investigation of the internal shear force of a simply supported beam under different point loads.

The experimental content has the following properties:

- ▶ Split beam allows the internal shear force at the split to be measured
- ▶ Up to 3kg of point loads can be applied to the beam across three movable weight hangers
- ▶ Adjustable simple supports

Requirements

1Ph  
SV  
100  
SV101  
Interface



### Bending Moments in a Beam – SV302

The Bending Moment in a Beam allows the experimental investigation of the internal bending moment of a simply supported beam under different point loads.

The experimental content has the following properties:

- ▶ Split beam allows the internal bending moment at the split to be measured
- ▶ Up to 3kg of point loads can be applied to the beam across three movable weight hangers
- ▶ Adjustable simple supports

Requirements

1Ph  
SV  
100  
SV101  
Interface





## Bridges, Beams, Arches and Cables

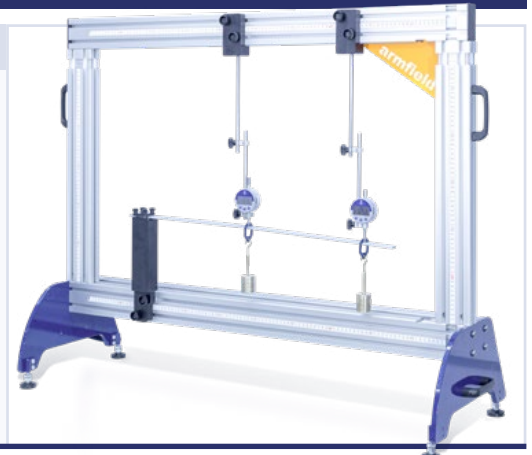
## Requirements

**Deflection of Beams and Cantilevers – SV303**SV  
100

The Deflection of Beams and Cantilevers allows the experimental investigation of the deflection of beams of different section sizes under different loads and types of support.

The experimental content has the following properties:

- ▶ Assembly of multiple different beam experiments via 2 adjustable supports, point load weight hangers and UDL weight sleeves
- ▶ 3 Different beam specimens of different section sizes and material



## Requirements

**Equilibrium of Forces – SV304**SV  
100

The Equilibrium of Forces allows the experimental investigation of non-concurrent forces creating equilibrium in a system.

The experimental content has the following properties:

- ▶ Ability to show non-concurrent equilibrium in a system using an equilibrium beam
- ▶ Ladder type beam with multiple locations to add additional weight up to a total beam weight of 470g
- ▶ Adjustable simple supports allowing the angle of the ladder beam to be adjusted
- ▶ Up to 1500g of reaction weights to measure the vertical and horizontal reaction forces at each end of the beam



## Requirements

**Suspension Cable – SV305**SV  
100

This Suspension Cable allows the experimental investigation of a cable free-hanging between 2 roller supports under its own dead-weight.

The experimental content has the following properties:

- ▶ Roller chain to simulate flexible cable
- ▶ Up to 4kg of additional weight to simulate increased dead-weight of chain
- ▶ Adjustable roller supports
- ▶ Moveable vertical scale



## Requirements

**Bending Stress in a Beam – SV306**

1Ph

SV  
100SV101  
Interface

The Bending Stress in a Beam allows the experimental investigation of the internal stresses of a simply supported beam placed into four-point bending.

The experimental content has the following properties:

- ▶ T section beam fitted with five strain gauges to measure the strain at various points on the section
- ▶ Load cell assembly to apply any load up to 500N via a load application bracket, evenly distributing the load over two points
- ▶ Adjustable simple supports



## Forces and Moments



### Simple Suspension Bridge – SV400

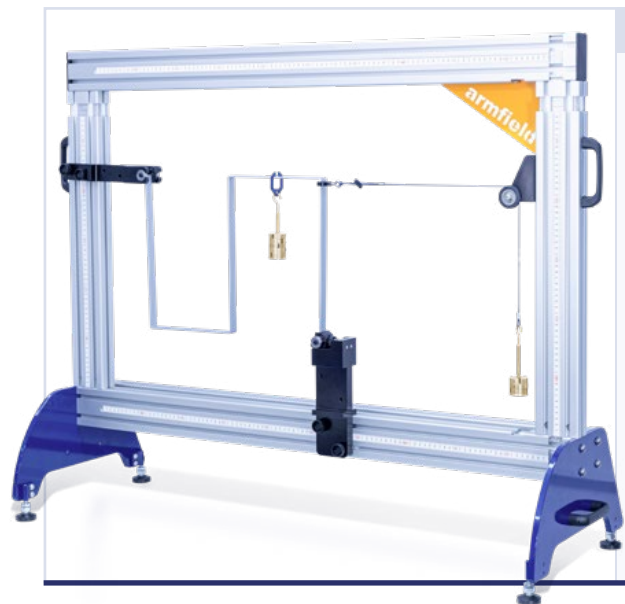
The Simple Suspension Bridge allows the experimental investigation of the tension in the main cable of a suspension bridge under different load conditions.

The experimental content has the following properties:

- ▶ Suspension bridge hung between 2 pulley supports with a rigid bridge deck
- ▶ Up to 1.35kg of additional weight to simulate UDLs (uniformly distributed loads) and point loads
- ▶ Load cell to measure tension in the main cable at the support

Requirements

1Ph  
SV 100  
SV101 Interface



### Deflection of a Frame – SV401

The Deflection of Frames allows the experimental investigation of the horizontal thrust and deflection observed when loads are applied to different shaped frames.

The measurements taken can then also be used to validate calculated values for the horizontal thrust and deflections found using Castigliano's Theorem.

The experimental content has the following properties:

- ▶ Two different shaped frame specimens
- ▶ Up to 1kg of weight hangers to apply loads to the specimens
- ▶ Digital indicators to measure deflection at different points on the frame
- ▶ Pivoting support capable of measuring horizontal thrust

Requirements

1Ph  
SV 100  
SV101 Interface  
SV102 Pinned Support



### Suspended Centre Span Bridge – SV402

The Suspended Centre Span Bridge allows the experimental investigation of different forces acting on a bridge with a central section suspended by the two outer cantilever sections of the bridge.

The experimental content has the following properties:

- ▶ Ability to show mechanical principles of a centre span bridge
- ▶ Ability to show reaction forces at the supports via three load cells covering half of the bridges span
- ▶ Point loads, UDLs (uniformly distributed loads) and rolling loads can be applied to the bridge

Requirements

1Ph  
SV 100  
SV101 Interface





## Forces and Moments

## Requirements

**Three-Pinned Arch – SV403**

1Ph

SV  
100SV101  
InterfaceSV102  
Pinned  
Support

The Three-Pinned Arch allows the experimental investigation of the horizontal thrust observed when loads are applied to an arch with hinges at each end as well as at the peak of the arch.

The measurements taken can then also be used to validate calculated values for the horizontal thrust found using the static equilibrium equations.

The experimental content has the following properties:

- ▶ Ability to show mechanical principles of three hinged arches
- ▶ Point loads, UDLs (uniformly distributed loads) and rolling loads can be applied to the arch
- ▶ Pivoting support capable of measuring horizontal thrust



## Requirements

**Two-Pinned Arch – SV404**

1Ph

SV  
100SV101  
InterfaceSV102  
Pinned  
Support

The Two-Pinned Arch allows the experimental investigation of the horizontal thrust observed when loads are applied to an arch with hinges at each end.

The measurements taken can then also be used to validate calculated values for the horizontal thrust and deflections found using Castiglano's Theorem.

The experimental content has the following properties:

- ▶ Ability to show mechanical principles of two hinged arches
- ▶ Both point loads and UDLs can be simulated
- ▶ Pivoting support capable of measuring horizontal thrust
- ▶ Digital indicator used to measure arch deflection



## Requirements

**Semi Circular Arch – SV405**

1Ph

SV  
100SV101  
InterfaceSV102  
Pinned  
Support

The Semi Circular Arch allows the experimental investigation of the horizontal thrust observed when loads are applied to a semi circular arch with hinges at each end.

The measurements taken can then also be used to validate calculated values for the horizontal thrust and deflections found using Castiglano's Theorem.

The experimental content has the following properties:

- ▶ Ability to show mechanical principles of semi circular arches
- ▶ Both point loads and UDLs can be simulated
- ▶ Pivoting support capable of measuring horizontal thrust
- ▶ Digital indicator used to measure arch deflection



## Strength of Materials



### Continuous and Indeterminate Beams – SV500

The Continuous and Indeterminate Beams allows the experimental investigation of the deflection of beams and the resulting reaction forces at the supports for multiple different continuous and indeterminate set-ups.

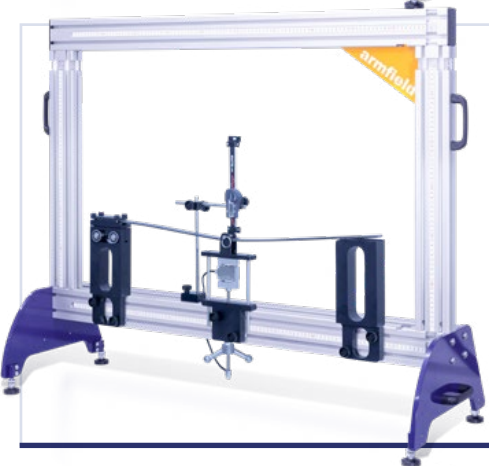
The experimental content has the following properties:

- ▶ Assembly of multiple different beam experiments via two sinking and one fixed support capable of measuring reaction loads, a fixed support capable of measuring fixing moment, point load weight hangers and UDL weight sleeves
- ▶ 3 different beam specimens of different section sizes and material
- ▶ Measurement of beam deflection using a digital indicator

1Ph

SV  
100

SV101  
Interface



### Plastic Bending of Beams – SV501

The Plastic Bending of Beams allows the experimental investigation of how beams behave when placed under a vertical load that causes plastic bending.

The experimental content has the following properties:

- ▶ Assembly of a simply supported, propped cantilever or encastre beam set-up
- ▶ 3 different beam specimens with additional spare beam kits available
- ▶ Load cell assembly for applying vertical loading
- ▶ Linear scale to measure the deflection of the beam at the point of loading

1Ph

SV  
100

SV101  
Interface



### Plastic Bending of Portals – SV502

The Plastic Bending of Portals experiment allows the experimental investigation of portal frames placed under horizontal and/or vertical loads resulting in plastic deformation.

The experimental content has the following properties:

- ▶ Two load cell assemblies for independent vertical and horizontal loading
- ▶ Adjustable pulley assembly to maintain true vertical and horizontal loading
- ▶ Two different portal types, rectangular and pitched portals, 3 of each type supplied with each kit and additional portal kits available
- ▶ Linear scales to measure the deformation of the portal at each load point

1Ph

SV  
100

SV101  
Interface



### Deflection of Curved Bars – SV503

The Deflection of Curved Bars allows the experimental investigation of the deflection observed when a load is applied to different shaped curved bars as well as being able to validate calculated deflections found using Castigliano's Theorem.

The experimental content has the following properties:

- ▶ Six different curved bar specimens
- ▶ Up to 1.5kg of weight hangers to apply load to the specimens
- ▶ Two digital indicators to measure vertical and horizontal deflection

1Ph

SV  
100





## Torsion and Buckling

**Buckling of Struts – SV600**

1Ph

SV  
100SV101  
Interface

The experiment Buckling of Struts allows the experimental investigation of the loads needed to cause buckling between different fixing conditions and lengths of sample.

The sample material will remain the same throughout to encourage consistency.

The experimental content has the following properties:

- ▶ Buckling specimens secured between two fixing conditions that are attached to mounting blocks
- ▶ Load cell to measure the applied load and digital linear scale to measure the displacement caused by buckling. The digital linear scale can be placed anywhere along the strut to find maximum buckling

**Unsymmetrical Bending and Shear – SV601**

1Ph

SV  
100

This experiment allows the experimental investigation of the deflection observed when a load is applied to unsymmetrical bars as well as being able to assess the location of the shear centre of these beams.

The experimental content has the following properties:

- ▶ Three different bar section specimens
- ▶ Up to 1000g of weight hangers to apply load to the specimens
- ▶ Two digital indicators to measure total horizontal deflection

**Torsion of Rods and Tubes – SV602**

1Ph

SV  
100

The experiment Torsion of Rods and Tubes allows the experimental investigation of the torsional differences between specimens of various material properties under different load conditions.

The experimental content has the following properties:

- ▶ Torsion specimens secured between 2 chucks fixed to a pair of supports
- ▶ Inclinometers to measure angular displacement of rod specimens at varying torsional loads, effective lengths and cross-sectional areas





# SV armBUS Software

Supplied as standard with all Armfield SV Structures experiments

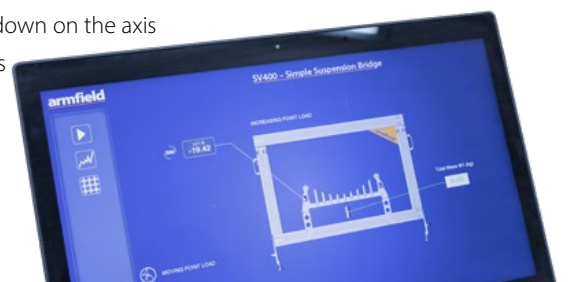


## Features of the armSOFT SV Series Educational Software

The Structures range utilises the **Armfield armBUS** software system to collect, display and store the data from the instrumentation. Each experiment has its individual GUI called on from a simple to use menu system.

The details are exercise specific, but typically the following interfaces are available:

- ▶ Full Graphical User Interface (GUI) for each experiment with display screens tailored for each exercise
- ▶ Individual experiments of the utilised kit can be accessed without restarting the software
- ▶ All strain gauges and load cell assemblies are displayed on a diagrammatic representation of the equipment in real time
- ▶ Allows manual input of data from DTI gauges and digital callipers
- ▶ Sensor data is collated, and calculations are displayed in a data-log, a tabulation function provided with the armBUS software. The data is in tabulated format and can be saved and accessed through a .csv file compatible with software such as Microsoft Excel
- ▶ Data sampling intervals can be user defined in seconds when the automatic sampling method is chosen
- ▶ The data from the sensors is plotted and displayed in a user configurable graphing function of the software. It can be displayed separately from the data logging and each sensor output can be viewed independently. The power graphing software provides the following functionality:
  - Date: Displays the data log date
  - Range: Displays the current chart range (Minute / Hour / Day)
  - Offset: Displays the step number back from the measured timestamp
  - Sensor Selection Window
  - Pan: Allows users to change the scale for the chosen unit by scrolling up and down on the axis
  - User defined scale: Set the min and max values for axes of measured parameters
  - Back: Step backward through the chart from the latest timestamp
  - Forward: Step forward through the chart to the latest timestamp
  - Time (Range)
  - User configuration of background colour
  - Line / dots: User definable line types





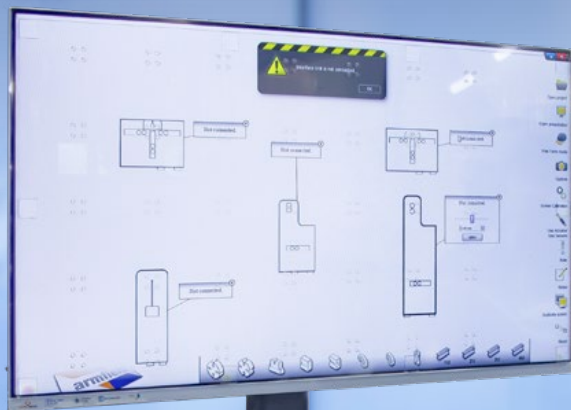


The Armfield ST series is designed to understand structural behaviour and by combining hardware and software, diagrams are displayed immediately behind the structure.

A pioneering new approach to the teaching of structural engineering. A fusion of innovative software, unique hardware and the authoritative textbook provide a firm foundation on the understanding of structural behaviour.

**Features Include:**

- ▶ Intuitive design providing great touch and feel
- ▶ Carbon fibre elements provide exaggerated response for enhanced visualisation
- ▶ Carbon fibre elements also provide negligible plastic deformation for long life and repeatability
- ▶ Eight standard projects including cantilevers, beams and portal frames
- ▶ Wide range of additional structures can be constructed from simple components
- ▶ Compare computer simulations with actual responses
- ▶ Sensor and instrumentation package
- ▶ Supplied with the textbook **Understanding Structural Analysis** by Dr David Brohn



Link to web page



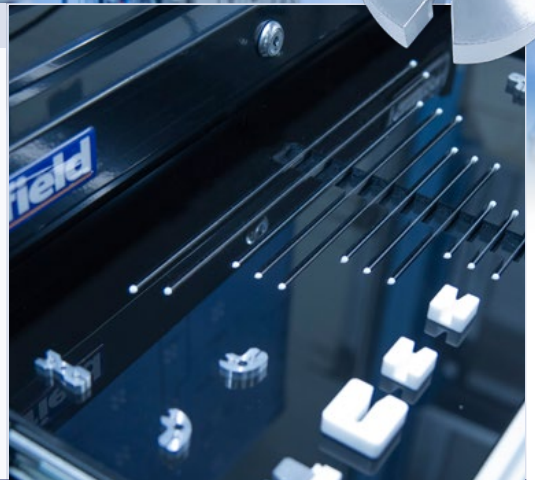
## Understanding Structural Behaviour ST10

**ST10 comprises:**

- ▶ Eight standard projects including cantilevers, beams and portal frames
- ▶ Backboard matrix for building the physical structure model
- ▶ Set of elements, supports and joints for the above range of structures to be implemented (many others can also be implemented)
- ▶ 32" High definition display with HDMI interface
- ▶ Display and Visualisation software
- ▶ RISA 2D models
- ▶ Book "Understanding Structural Analysis" by Dr. David Brohn – Includes demo version of QSE Analysis software
- ▶ Storage facility for all components

Capabilities can be extended by the addition of the Instrumentation Package ST11

- 1Ph
- PC
- USB



## Instrumentation Package ST11

**ST11 comprises:**

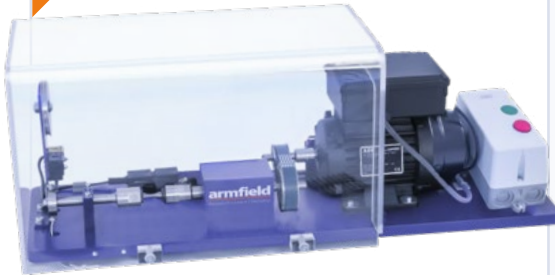
Deflection Sensor; Linear Actuator; Three Component Rigid Support Sensor; Two Component Pinned Support Sensor; Simple Support Sensor, Interface Unit plus power supply and interconnecting cables; Software for Control and Instrumentation functions is supplied with ST10.

**Note:** Additional sensors and actuators can be added later.

- 1Ph
- PC
- USB
- ST10



NEW



## Rotating Fatigue Machine - SV800

The SV800 rotating fatigue machine has been designed to introduce students to the effects of material fatigue using a sinusoidal variation of bending stress.

### Experimental Content:

- ▶ To make an introductory study of fatigue using a Wohler rotating fatigue apparatus, including the time to failure caused by various stress levels and materials
- ▶ Introducing students to S-N curves
- ▶ Material specification on fatigue limits
- ▶ Specimen geometry on fatigue limit

AIU - Armfield Interface Unit



### Requirements

- 1Ph
- PC
- USB
- AIU



NEW



## Unsymmetrical Cantilever Apparatus - SV801

The SV801 Unsymmetrical Cantilever Apparatus allows the vertical and horizontal deflections of the free end of a test specimen to be measured when loading occurs along a principle axis or at a known angle. A solid compact base holds a rigid vertical end support for the clamping of three cantilevers.

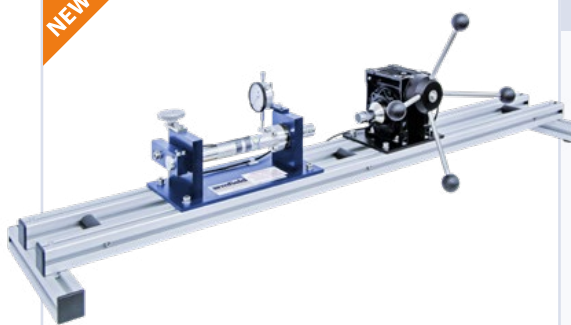
### Experimental Content:

- ▶ Vertical and horizontal deflection of unsymmetrical cantilevers
- ▶ Mohr's circle
- ▶ Moment of area
- ▶ Shear centre location
- ▶ Comparison between actual and theoretical results

### Requirements



NEW



## Torsion Testing Machine 30Nm - SV802

Up to 30Nm torque is applied via the moment head to differing material test specimens using hand operated worm and wheel gearbox (60:1 ratio).

The unit can cater for test specimens of up to 750mm between the moment head and torsion head. The moment head is fixed but the torsion head can be moved along the base to allow for the different lengths of specimen.

### Experimental Content:

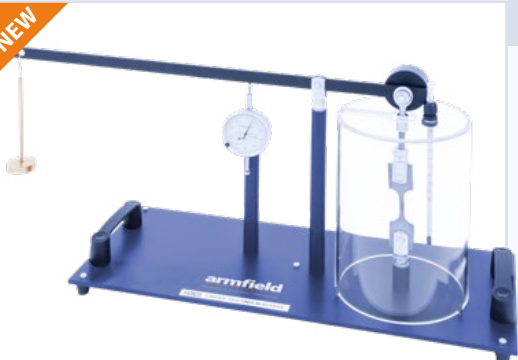
- ▶ Torsional loading to failure of varying material specimens
- ▶ Torsional variation due to material, cross sectional area
- ▶ Comparison between actual and theoretical results
- ▶ Determination of the Modulus of Rigidity and Yield Shear Stress
- ▶ Working with the elastic torsion equation
- ▶ Hardness testing

### Requirements

- 1Ph
- PC
- USB
- AIU



NEW



## Creep Testing Machine - SV803

A sturdy bench top mounted unit for studying the effect of creep on different material test specimens. Necked test specimens are held vertically in position on special clamps, which do not induce bending during loading.

A lever arm transmits the load from a load hanger and weights into the specimen and the lever arm has a counter balance weight to ensure the lever arm self-weight is calibrated out.

### Experimental Content:

- ▶ Creep fracture load
- ▶ Temperature effect on creep rate and failure
- ▶ Material variation on creep rate and failure
- ▶ Load variation on creep rate and failure

### Requirements





Requirements

## Pendulum Impact Tester 25J Impact Energy- SV804

1Ph

A sturdy bench top mounted unit for the study of notched bar (Charpy) impact strength tests. A heavy base plate with protective guard surrounds all the components, the guard has a lockable door for ease of access when setting the test but also security whilst not in use.

The base plate has an anvil and pillar which have replicable impact profiles for supporting the notched specimens prior to testing.

**Experimental Content:**

- ▶ Tensile and Compression Testing
- ▶ Recording of Stress-Strain Diagrams
- ▶ Modulus of Elasticity Testing
- ▶ Percentage Elongation
- ▶ Deep Draw Testing
- ▶ Three-Point Bending
- ▶ Hardness Testing
- ▶ Shear (unsymmetrical, symmetrical shear both supported and unsupported)



NEW

Requirements

## Universal Materials Tester 35kN - SV805

1Ph

PC

USB

AIU

The SV805 is a modular, flexible, compact, safe, materials tester allowing students to conduct up to 6 experiments on 7 different material types.

The results of these experiments allow students to gain understanding of materials properties and how the performance of these effects design.

**Experimental Content:**

- ▶ Tensile and compression testing
- ▶ Shear (unsymmetrical, symmetrical shear both supported and unsupported)
- ▶ Recording of stress-strain diagrams
- ▶ Modulus of elasticity testing
- ▶ Percentage elongation
- ▶ Deep draw testing
- ▶ Three-point bending
- ▶ Hardness testing



NEW

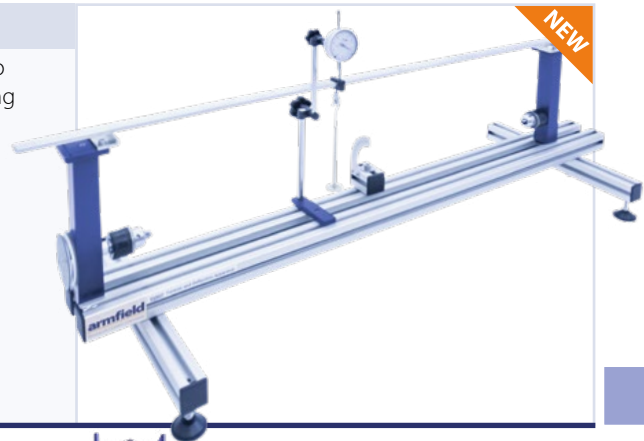
Requirements

## Torsion & Deflection Testing Apparatus - SV807

This benchtop unit allows a variety of experiments to be undertaken to investigate test specimens under torsional loading and bending loading within their elastic limits.

**Related Laws:**

- ▶ Mechanical Engineering
- ▶ Structural Engineering
- ▶ Stress
- ▶ Bending
- ▶ Torsion
- ▶ Deflection
- ▶ Span
- ▶ Bending Theory
- ▶ Modulus of Rigidity
- ▶ Super-position



NEW

Requirements

## Extension of Springs Apparatus - SV808

SV 100

Extension of Springs Apparatus, to test the relationship between the load applied and the change in length of a spring (Hooke's Law) also determine spring stiffness using measured spring data and load versus extension graphs, this device will cater for a number of working with springs exercises.

**Related Laws:**

- ▶ Hooke's Law
- ▶ Spring rate
- ▶ Wire
- ▶ Extension



NEW

## Friction - SV Series



### Friction on an Inclined Plane - SV900

The Armfield SV900 Friction on an Inclined Plane is a compact bench top unit supplied with a sturdy aluminium base plate, non-slip feet and central vertical pillar. Pivoting on this base is a ground steel plane which can be locked in any angular position between  $\pm 45^\circ$ , indicated on a semicircular protractor scale.

#### Experimental Content:

- ▶ To determine the coefficient of friction under static and sliding conditions between various materials and steel
- ▶ To verify the angle of friction for the material
- ▶ To measure the force required to move a body up an inclined plane against gravity and friction
- ▶ To show the equilibrium of forces on an inclined plane

Requirements



### Clutch Plate Friction Apparatus - SV901

The wall mounted apparatus comprises a lower stationary plate attached to a sturdy wall mounting bracket. On top of this stationary disc sits an upper aluminium alloy plate whose shaft rotates in ball bearings but which is in direct contact with the stationary plate.

#### Experimental Content:

- ▶ To determine the coefficient of friction of the plate material
- ▶ To show that the minimum torque to maintain rotation is proportional to the axial load and diameter of the friction disc

Requirements

SV  
100



### Pivot Friction Apparatus - SV902

The apparatus consists of a rotating circular turntable attached onto the end of a vertical shaft. The shaft is held vertical within a sturdy wall bracket that must be attached to a rigid vertical surface, i.e. a wall or the SV100 Bench Mounted Frame.

#### Experimental Content:

- ▶ To investigate the relationship between frictional torque and axial thrust
- ▶ To determine the influence of the bearing cone angle
- ▶ To obtain the coefficient of friction for different bearings

Requirements

SV  
100



### Journal Friction Apparatus - SV903

This apparatus is designed to determine the friction torque in a plain journal bearing under varying conditions of load, speed and lubrication.

#### Related Laws:

- |              |               |
|--------------|---------------|
| ▶ Automotive | ▶ Bearing     |
| ▶ Friction   | ▶ Wear        |
| ▶ Machines   | ▶ Torque      |
| ▶ Clutches   | ▶ Slip        |
| ▶ Brakes     | ▶ Lubrication |

Requirements

1Ph





Requirements

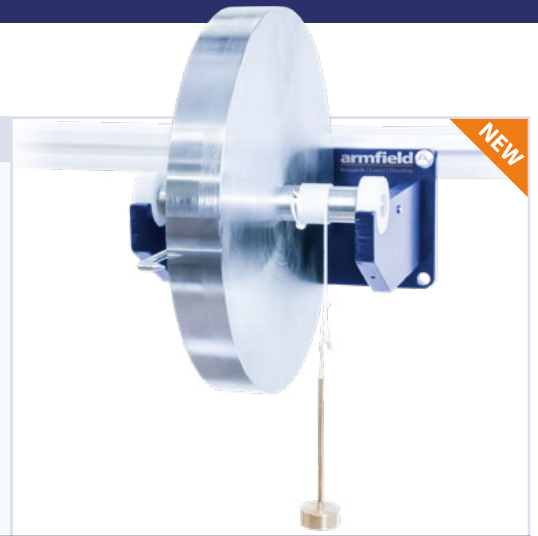
## Bearing Friction Apparatus - SV904

SV  
100

Allows students to compare the frictional losses of bearings by measuring the coefficient of sliding friction between pairs of materials.

**Experimental Content:**

- ▶ Allows students to compare the frictional losses of bearings by measuring the coefficient of sliding friction between pairs of materials
- ▶ Allows students to measure the compare and contrast losses when comparing different bearing types



NEW

Requirements

## Rope Belt Friction Apparatus - SV905

SV  
100

A wall mounted fixed pulley with a loaded belt. Four different pulleys are supplied with different vee groove angles; flat rim, 60°, 90° and 120°.

**Demonstration Capabilities:**

- ▶ To investigate the ratio of belt tensions when a rope passes over pulleys of different Vee angle
- ▶ To determine the coefficient of friction between the steel pulley and cotton rope
- ▶ To assess the variation of belt tension ratio with lap angle



NEW

Requirements

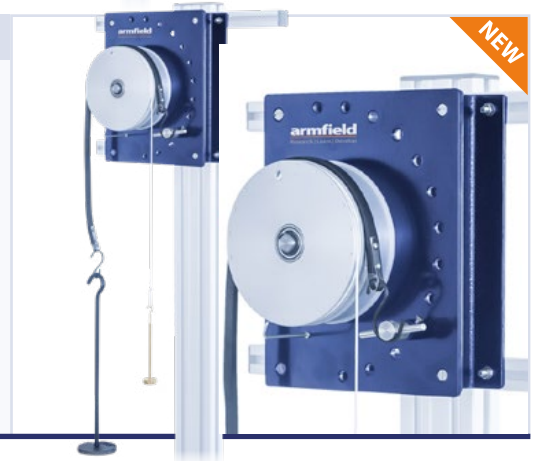
## Friction of Belts Apparatus - SV906

SV  
100

Wall or frame mounted apparatus to observe the relationship between the tensions in the two sides of a belt.

**Experimental Content:**

- ▶ To observe the relationship between the tensions in the two sides of a belt
- ▶ To assess the differences between vee, rope and flat belts
- ▶ To determine the coefficient of friction between the pulley and belt for the belt sections
- ▶ To investigate the effect of angle of lap



NEW

Requirements

## Brake Drum Friction Apparatus - SV907

Bench top mounted brake drum. Torque is applied to the brake drum by using the calibrated weights set provided and load hanger.

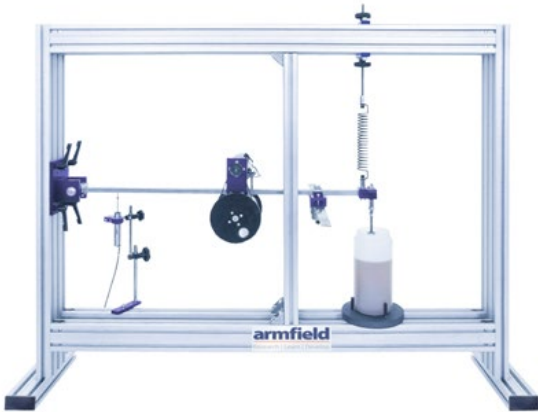
**Demonstration Capabilities:**

- ▶ To determine experimentally the variation of tangential force with braking load
- ▶ To obtain the coefficient of friction between the aluminium drum and the brake shoe
- ▶ To compare leading and trailing shoes



NEW

NEW



\* Requires INST063 PC USB Oscilloscope

## Universal Vibration System - SD2

This system contains all the necessary parts to undertake free and forced vibration, resonance and damping. A beam pivots at one end from a bracket and bearing attached to the Vibration Frame.

A spring is attached to the free end of the beam to enable the beam to vibrate. The horizontal position of the spring can be adjusted using the integral adjustment system, and vibration travel is restricted via factory set "stops".

### Experimental Content:

- ▶ Spring stiffness
- ▶ Resonance frequency
- ▶ Active and inactive damping absorber
- ▶ Free vibration
- ▶ Forced vibration
- ▶ Damped vibration
- ▶ Damping ratio
- ▶ Tuning of damping absorber
- ▶ Amplitude response and phase response
- ▶ Specimen geometry on fatigue limit

Requirements

- 1Ph
- PC
- USB
- AIU



NEW



\* Requires INST063 PC USB Oscilloscope

## Torsional Vibration Apparatus - SD3

This benchtop mounted unit is used to study torsion and torsional vibration. The apparatus is constructed around a profiled aluminium base with levelling feet, onto which is mounted 4 vertical chuck pillars.

### Experimental Content:

- ▶ Determination of the torsional stiffness of a torsion bar
- ▶ Determination of the mass moment of inertia
- ▶ Decay behaviour of torsional vibration
- ▶ Forced torsional vibration and resonance
- ▶ Torsional vibration system with three weights allowing single, two and three mass torsional vibration to be investigated
- ▶ Demonstration of the effect of frictional damping

Requirements

- 1Ph
- PC
- USB
- AIU



NEW



## Armfield Interface Unit - AIU

The AIU4 Interface Console links sensors with electronic outputs to the laptop or PC. The console interprets the signals received into the correct output format for the armBUS software.

The console has a 24vDC power supply to reduce the risk of high voltage incidents with contact with water

Requirements

- 1Ph
- PC
- USB





Requirements

## Wheel and Axle - SD-1.50

SV  
100

The dual diameter wheel has an axle supported on simple pivots in a sturdy wall mounting bracket. Each wheel has a cord wrapped around its periphery.

The cords can be wrapped in either direction around each wheel. A load hanger is added to each cord allowing loading of the wheels using the calibrated weights set provided.

**Experimental Content:**

- ▶ Experimental determination of velocity ratio and comparison with calculated value
- ▶ Determination of variation with load of effort
- ▶ Determination of variation with load of efficiency



NEW

Requirements

## Wheel and Differential Axle Apparatus - SD-1.51

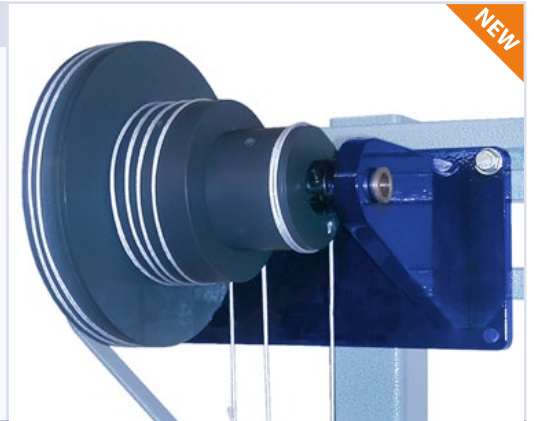
SV  
100

A wheel is attached to a differential axle assembly of  $\varnothing 114\text{mm}$  (major axle) and  $\varnothing 38\text{mm}$  (minor axle). The wheel and differential axle are secured to a shaft that runs in bearings within a sturdy wall mounting bracket.

*All necessary cords, load hangers and weights are provided.*

**Experimental Content:**

- ▶ Comparison with calculated values for simple wheel and differential axle machine
- ▶ Determination of variation with load of limiting efficiency of the machine
- ▶ Experimental determination of velocity ratio
- ▶ Determination of variation with load of effort
- ▶ Determination of variation with load of efficiency



NEW

Requirements

## Efficiency of Screw Threads - SD-1.52

SV  
100

Three screw thread forms are supplied ('Vee' x 2 and square) each with an integral turntable mounted on the top side. Wrapped around the periphery of the turntable is a cord which allows the turntable to be rotated when loaded.

**Experimental Content:**

- ▶ Experimental determination of velocity ratio and comparison with calculated value
- ▶ Comparison of relative efficiency of Vee and Square thread forms
- ▶ Determination of variation with load of effort, friction and efficiency
- ▶ Limiting efficiency of the machine



NEW

Requirements

## Gear Tooth Form Apparatus - SD-1.53

A bench top base plate contains all elements for this experiment.

Three gears are located onto the base plate. A large gear and small gear mesh together and can be rotated to produce analysis of ratios. A third gear is removable to allow students to review its tooth form, pitch circle diameter (PCD) and other key geometry of a tooth form.

**Experimental Content:**

- ▶ Experimental determination of shape and construction of an involute curve
- ▶ Explanation of Gear Form
- ▶ Explanation of Gear Ratios
- ▶ Explanation of Gear Modules
- ▶ Explanation of Gear Trains and Rotational Direction



NEW

 <p><b>NEW</b></p>	<p><b>Cam and Follower Apparatus - SD-1.54</b></p> <p>A vertical pillar contains the main spindle for each cam to be rotated, whilst a dial gauge has its anvil resting on the top edge of the cam.</p> <p><b>Experimental Content:</b></p> <ul style="list-style-type: none"> <li>▶ To determine a graph of follower displacement against angular rotation of the cam</li> <li>▶ To assess the effect of different cams and followers</li> <li>▶ To derive the velocity and acceleration diagrams, and determine the maximum acceleration of the follower</li> <li>▶ To compare experimental and calculated results</li> </ul>	<p>Requirements</p> <p>SV 100</p>
 <p><b>NEW</b></p>	<p><b>Simple Flywheel - SD-1.55</b></p> <p>Experiment to verify the second law of motion applied to a flywheel.</p> <p><b>Experimental Content:</b></p> <ul style="list-style-type: none"> <li>▶ To verify the second law of motion applied to a flywheel, i.e. the relationship between torque and angular acceleration</li> <li>▶ To compare experimental and calculated moments of inertia of a disc</li> <li>▶ To study the energy transformations and to demonstrate that a flywheel can be used to store energy</li> </ul>	<p>Requirements</p> <p>SV 100</p>
 <p><b>NEW</b></p>	<p><b>Epicyclic Gear Train - SD-1.56</b></p> <p>This apparatus consists of two standard epicyclic gear trains. Each gear train consists of a sun gear in the centre, three planet gears, a planet linkage and an internal or ring gear.</p> <p>The sun gear, ring gear and planet carrier all rotate about the same axis.</p> <p><b>Experimental Content:</b></p> <ul style="list-style-type: none"> <li>▶ Calculate and experimentally observe the angular velocity ratios of gear trains</li> <li>▶ Calculate the efficiencies of gear trains and draw efficiency curve</li> <li>▶ Experimentally obtain the torque ratios of gear trains, gear ratios, efficiencies and velocity ratios can be calculated can be used to store energy</li> </ul>	<p>Requirements</p> <p>SV 100</p>
 <p><b>NEW</b></p>	<p><b>Castor, Camber and King Pin Inclination - SD-1.57</b></p> <p>This apparatus shows precisely how castor, camber and king pin inclination are set up and how centre point steering is achieved.</p> <p><b>Experimental Content:</b></p> <ul style="list-style-type: none"> <li>▶ To show how castor, camber and king pin inclination are set up</li> <li>▶ To show how the steering linkage is related to toe-in</li> <li>▶ To demonstrate the effect of wheel offset</li> <li>▶ To observe the dynamic stability of the wheel under running conditions</li> <li>▶ To measure the forces on the steering link</li> <li>▶ To show how the weight of the car affects self centring</li> </ul>	<p>Requirements</p>
 <p><b>NEW</b></p>	<p><b>Relation Between Angular and Linear Speeds - SD-1.58</b></p> <p>To find the relationship between angular rotation and the peripheral movement of the stepped shaft.</p> <p><b>Experimental Content:</b></p> <ul style="list-style-type: none"> <li>▶ To find the relationship between angular rotation and the peripheral movement of the stepped shaft</li> <li>▶ Compare actual results with theory</li> </ul>	<p>Requirements</p>



## Requirements

### Disc Brake Apparatus - SD-1.59

SV  
100

Through the load hanger and calibrated weights the force is applied to the brake disc and the parameters of braking force, braking torque and normal force can be assessed.

#### Experimental Content:

- ▶ To determine the most effective brake pad material
- ▶ To determine the most efficient radial placing of the brake pad



NEW

## Requirements

### Static & Dynamic Balancing Apparatus - SD-1.60

1Ph

A bench mounted enclosure contains all the electronics and safety guard for this apparatus.

#### Experimental Content:

- ▶ Static balancing of non-coplanar masses
- ▶ Dynamic balancing of non-coplanar masses
- ▶ Comparison between theoretical and actual results
- ▶ Use of vector diagrams, vector resolution, resultant forces, moment polygons and turning moments



NEW

## Requirements

### Governor Apparatus - SD-1.61

1Ph

Compact, bench top apparatus to demonstrate the principle of operation of various centrifugal force governors.

#### Experimental Content:

- ▶ Geometry and operation of a Porter, Proell and Hartnell governor
- ▶ To observe the lift off speed of the three different types of governor
- ▶ To observe the stability of a governor
- ▶ To observe the affect of varying sleeve weight or spring force on the operation of a governor
- ▶ To compare actual results with calculated theoretical values



NEW

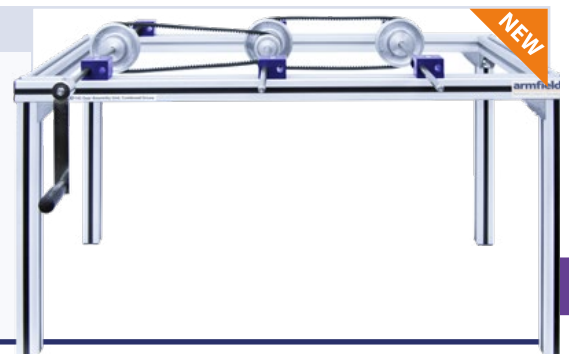
## Requirements

### Gear Assembly Unit Combined Drives - SD-1.62

Introduction to gear trains, transmissions, ratios and velocities and also spur gears, drive belts, pulleys, chains, tensioners, worm and wheel, bevel gears, rack and pinions, compound drives.

#### Related Laws:

- ▶ Automotive
- ▶ Assembly of different drive mechanisms, layout and meshing
- ▶ Industry standard drives
- ▶ To compare actual results with calculated theoretical values



NEW

## Requirements

### Single Epicyclic Gear Train - SD-1.63

SV  
100

The apparatus can be operated in one of a variety of modes. This gives the user different options on gear ratios that can be applied between the input and output shafts.

#### Experimental Content:

- ▶ Calculate and experimentally observe the angular velocity ratios of gear trains
- ▶ Experimentally obtain the torque ratios of gear trains
- ▶ Compute the efficiencies of gear trains



NEW



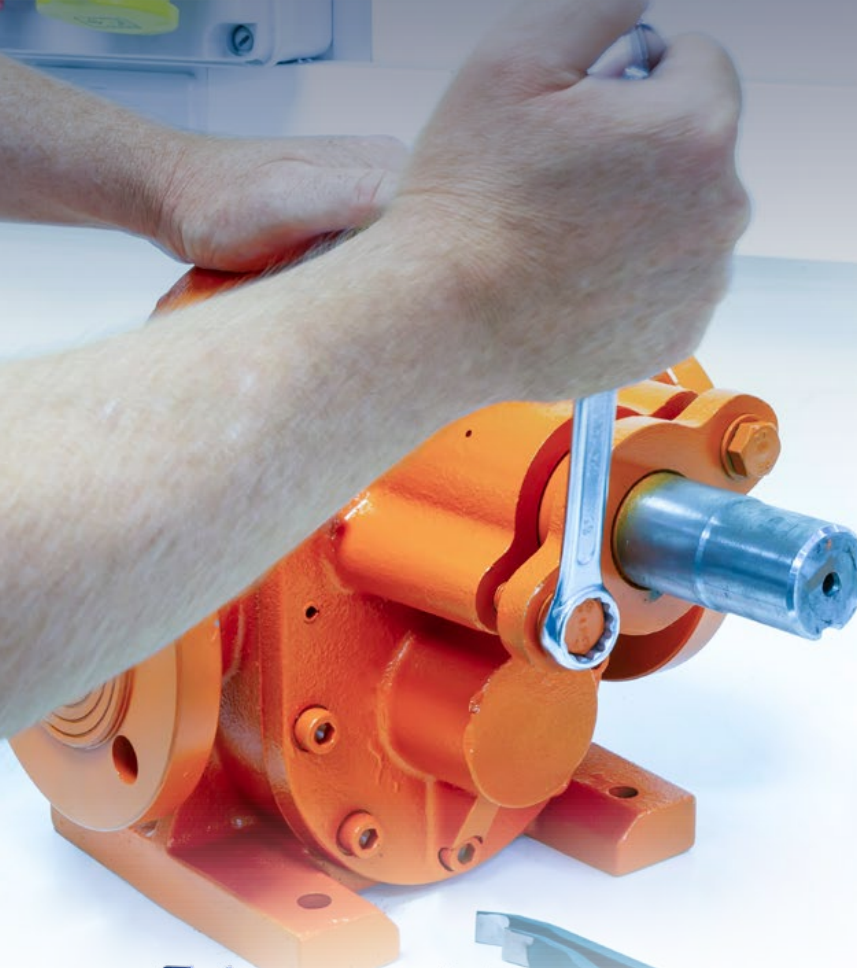
# Dissectible Pumps & Valves



Our dissectible maintenance training kits use new industrial pumps and valves that are commonly used in industrial parts

The Armfield Machine Elements product range has been designed to teach hands-on industrial skills, to prepare students for work in real industrial jobs. From stripping and repairing real industrial pumps, valves and equipment to understanding the construction and operation of heat exchangers.

The range allows student to fully understand the function and main components of universally used machine elements.



- ME61:** 2"/DN50 Single Stage Centrifugal Pump
- ME62:** 2"/DN50 Long Coupled Single-Stage Centrifugal Pump
- ME63:** 2"/DN50 4 Stage Centrifugal Pump
- ME64:** 2"/DN50 Internal Gear Pump
- ME65:** 2"/DN50 External Gear Pump
- ME66:** 1.5"/DN40 Vane Pump
- ME67:** 2"/DN50 Multi-Screw Pump
- ME68:** 2"/DN50 Lobe Pump
- ME69:** 2"/DN50 Diaphragm Pump
- ME70:** 2.5"/DN65 Tri-Rotor Rotary Piston Pump
- ME81:** 2"/DN50 Ball Valve
- ME82:** 2"/DN50 3-Way Ball Valve
- ME83:** 2"/DN50 Gate Valve
- ME84:** 2"/DN50 Globe Valve
- ME85:** 2"/DN50 Right-Angled Globe Valve
- ME86:** 2"/DN50 Diaphragm Valve
- ME87:** 2"/DN50 Butterfly Valve
- ME88:** 1"/DN25 Needle Valve
- ME89:** 2"/DN50 2-Port Plug (Cock) Valve
- ME90:** 2"/DN50 Ball Check Valve
- ME91:** 2"/DN50 Swing Check Valve
- ME92:** 2"/DN50 Disc Check Valve
- ME93:** 2"/DN50 Lift Check Valve
- ME94:** 2"/DN50 Electrically Actuated Ball Valve
- ME95:** 2"/DN50 Pneumatically Actuated Ball Valve
- ME96:** 2"/DN50 Control Valve without Positioner
- ME97:** 2"/DN50 Control Valve With Smart Positioner
- ME98:** 2"/DN50 Dissectible 3-Way Control Valve
- ME99:** 2"/DN50 Solenoid Valve
- ME100:** 2"/DN50 Pressure Reducing Valve
- ME101:** 2"/DN50 Spring Safety Relief Valve

NEW



ME65 - External Gear Pumps

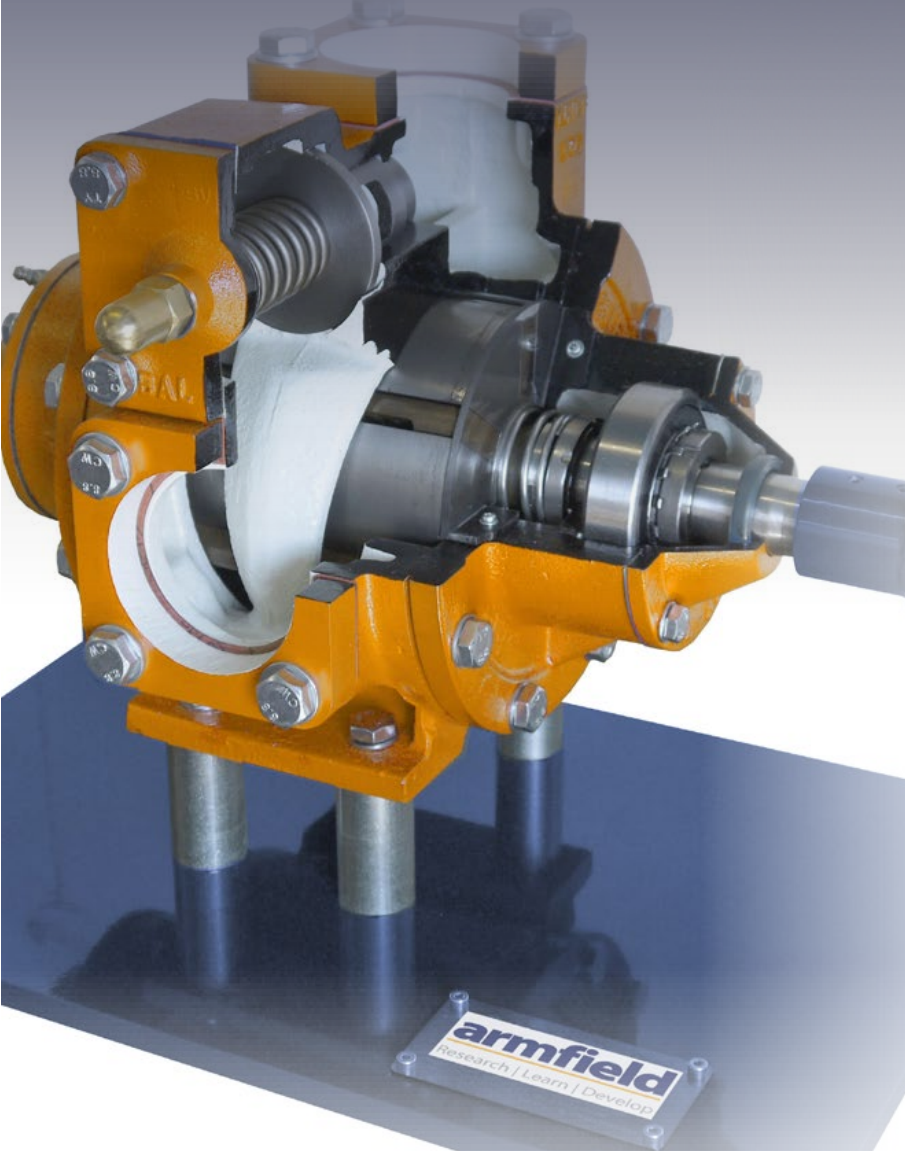




# Cutaway Pumps & Valves



Our cutaway pumps and valves are manufactured using brand new industrial pumps, sectioned, and mounted for easy visualisation of the internal pump's components such as impellers, shafts, bearings and flow paths.



- ME1:** 2"/DN50 Cutaway Centrifugal Pump, Close-Coupled
- ME2:** 2.5"/DN65 Cutaway Centrifugal pump, Long Coupled
- ME3:** 2"/DN50 Cutaway 4-Stage Centrifugal Pump
- ME4:** 2"/DN50 Cutaway Internal Gear Pump
- ME5:** 2"/DN50 Cutaway External Gear Pump
- ME6:** 2"/DN65 Cutaway Vane Pump
- ME7:** 2"/DN50 Cutaway Triple Screw Pump
- ME8:** 2"/DN50 Cutaway Triple Lobe Pump
- ME9:** 1.5"/DN40 Cutaway Diaphragm Pump (Ductile Iron)
- ME10:** 3/8"/DN10 Cutaway Diaphragm Metering/Dosing Pump
- ME21:** 2"/DN50 Cutaway Ball Valve
- ME22:** 2"/DN50 Cutaway 3 – way Ball Valve
- ME23:** 2"/DN50 Gate Valve
- ME24:** 2"/DN50 Globe Valve
- ME25:** 2"/DN50 Cutaway Right-Angle Globe Valve
- ME26:** 2"/DN50 Cutaway Weir Diaphragm Valve
- ME27:** 2"/DN50 Cutaway Butterfly Valve
- ME28:** 1"/DN25 Cutaway Needle Valve
- ME29:** 2"/DN50 Cutaway 2-Port Plug Cock Valve
- ME30:** 2"/DN50 Cutaway Ball Check Valve
- ME31:** 2"/DN50 Cutaway Swing Check Valve
- ME32:** 2"/DN50 Cutaway Disc Check Valve
- ME33:** 2"/DN50 Cutaway Lift Check Valve
- ME34:** 2"/DN50 Cutaway Electrically Actuated Ball Valve
- ME35:** 2"/DN50 Cutaway Pneumatically Actuated Ball Valve
- ME36:** 2"/DN50 Cutaway Control Valve without Positioner
- ME37:** 2"/DN50 Cutaway 3-Way Control Valve without Positioner
- ME38:** 2"/DN50 Cutaway Solenoid Valve
- ME39:** 2"/DN50 Cutaway Pressure reducing Valve
- ME40:** 2"/DN50 Cutaway Spring Safety Relief Valve

ME30 - Cutaway Ball Check Valve

M40 - Cutaway Spring Safety Relief Valve

M21 - Cutaway Ball Valve





# Fluid Science



Introduce students to the world of engineering at the earliest opportunity with Armfield's new Fluid Science range.

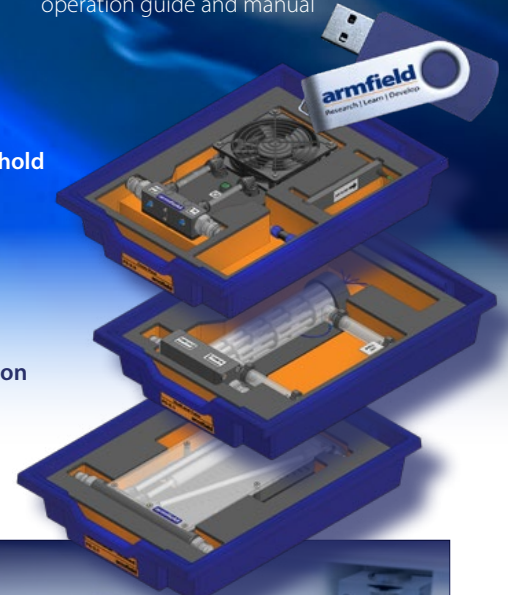
Built on a proven track record of developing innovative, hands-on teaching equipment; the Fluid Science range enables students to gain an understanding of the fundamentals of Fluid Mechanics and Thermo Fluids via hands-on experimentation.

Students can conduct individual or group experiments ranging from simple flow measurements and losses in hydraulic circuits through to more complex heat exchanger processes using the Fluid Science service unit in conjunction with the multi-functional work panel and instrumentation. A user friendly operational guide provides highly visual illustrations allowing the students to further their knowledge by applying the theories themselves to practical experimentation.

The high precision elements are presented in a modular tray based system providing both ease of access and storage.



Experiments are supplied in trays with USB operation guide and manual



## Fluid Science Service Unit - FS-SU

The Fluid Science Service Unit is designed to be used in conjunction with the fluid science experiments offered by Armfield. The unit incorporates a pump and rotameter to vary the water flow rate and a heating system. The built-in safety features of the unit include a thermal cut-out that prevents the hot water circuit exceeding 55°C and a low voltage water resistant power supply unit.

The high precision elements are supplied as modular tray-based systems which operate in conjunction with the Fluid Science Service Unit, multifunctional work panel and instrumentation enabling the student to conduct their individual or group experiments

### Requirements





Fluid Mechanics

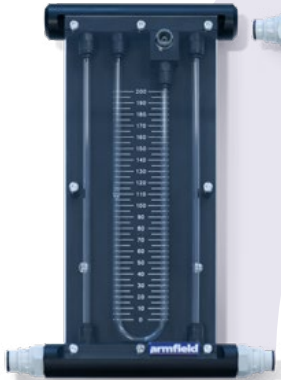
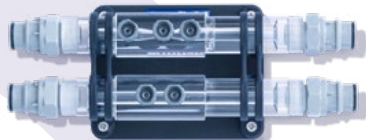
FS-2.1 - Manometer – Inclined



FS-1.2 - Energy Losses in Straight Pipes



FS-1.1 - Flow Measurement



FS-2.2 - Manometer – U Tube



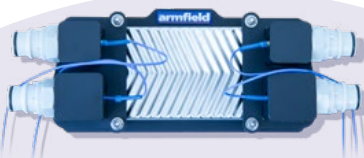
FS-1.3 - Energy Losses in Bends

Fluid Mechanics

Explore energy losses in pipes with three experiments trays covering the curriculum as well as studying flow using manometers.

Thermo Fluids

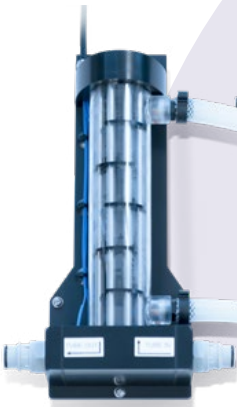
FS-3.4 - Plate Heat Exchanger



FS-3.2 - Tubular Heat Exchanger



FS-4.1 - Fluidised Bed



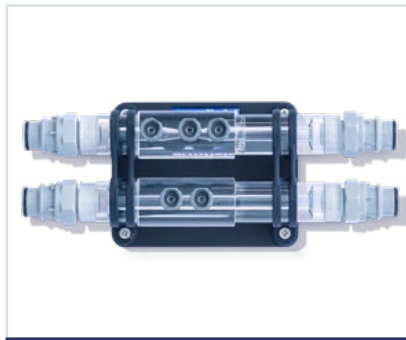
FS-3.1 - Shell & Tube Heat Exchanger



FS-3.3 - Cross Flow Heat Exchanger

Thermo Fluids

Using two base units to provide a hot and cold system to study entry level heat transfer, this series includes a fluidised bed tray.



## Fluid Science Flow Measurement - FS-1.1

Combined with the Fluid Science Service Unit, the Fluid Science Flow Measurement Tray, provides hands on experimentation designed to demonstrate flow measurement and the relationship between velocity and pressure drop.

Utilising the service unit the flow meters experiment rapidly mounts onto the multifunctional work panel and is connected to the built-in water supply via quick connect couplings. Differential pressure reading is taken using a digital manometer against varying flow rates.

### Requirements



## Energy Losses - Straight Pipes - FS-1.2

The Fluid Science Energy Losses in Straight Pipes Tray provides hands on experimentation designed to demonstrate energy losses due to the geometry of the flow path at different flow rates.

Utilising the service unit the experiments rapidly mount onto the multifunctional work panel and is connected to the built-in water supply via quick connect couplings. Differential pressure reading is taken using a digital manometer against varying flow rates.

### The tray includes the following Hydraulic Circuits:

- ▶ Smooth and Roughened pipe 6mm diameter
- ▶ Contraction and expansion 8mm – 4mm – 8mm diameters

### Requirements



## Energy Losses - Bends - FS-1.3

The Fluid Science Energy Losses in Bends Tray provides hands on experimentation designed to demonstrate energy losses due to the geometry of the flow path at different flow rates.

Utilising the service unit the experiments rapidly mount onto the multifunctional work panel and is connected to the built-in water supply via quick connect couplings. Differential pressure reading is taken using a digital manometer against varying flow rates.

### The tray includes the following Hydraulic Circuits:

- ▶ **Energy losses in bends** - Shallow bend radii 75mm, 6mm bore
- Tight bend radii 25mm, 6mm bore
- Mitre bend, 6mm bore

### Requirements



## Fluid Science Manometer - Inclined - FS-2.1

The Fluid Science Inclined Manometer tray includes experiments to measure small pressure differences and the effect of change in manometer inclination.

The tray additionally includes a stepped manometer that incorporates changes in cross section to demonstrate that the level of a free surface is not affected by the size or the shape of the tube.

### Requirements



## Fluid Science Manometer - U Tube - FS-2.2

The Fluid Science U-Tube Manometer tray includes experiments to compare the pressure created with varying flow rates against atmospheric pressure for both ends of a straight pipe.

It also demonstrates how the differential pressure changes as flow rate changes across a straight pipe.

### Requirements





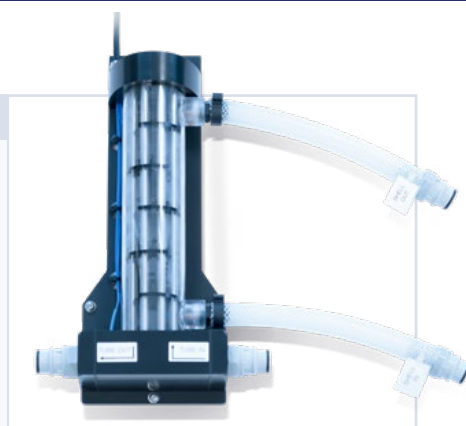
## Requirements

### Fluid Science Shell and Tube Heat Exchanger - FS-3.1



The Fluid Science Shell and Tube Heat Exchanger tray includes experimentation to demonstrate indirect heating or cooling by transfer of heat from one fluid stream to another when separated by a solid wall (fluid to fluid heat transfer) in a shell and tube heat exchanger.

The tray introduces students to concepts such as heat transfer coefficients, thermal resistances, controlling resistance and heat transfer driving forces. The heat exchanger can be used in a co-current or countercurrent configuration.



## Requirements

### Fluid Science Tubular Heat Exchanger - FS-3.2



The Fluid Science Tubular Exchanger tray includes experimentation to demonstrate indirect heating or cooling by transfer of heat from one fluid stream to another when separated by a solid wall (fluid to fluid heat transfer) in a tubular heat exchanger.

The tray introduces students to concepts such as heat transfer coefficients, thermal resistances, controlling resistance and heat transfer driving forces. The heat exchanger can be used in a co-current or countercurrent configuration.



## Requirements

### Fluid Science Cross Flow Heat Exchanger - FS-3.3



The Fluid Science Cross Flow Heat Exchanger tray includes experimentation to demonstrate indirect heating or cooling by transfer of heat from hot water to air (fluid to air heat transfer) in a cross flow heat exchanger.

The tray introduces students to concepts such as heat transfer coefficients, thermal resistances, controlling resistance and heat transfer driving forces. The heat exchanger can be used in a co-current or countercurrent configuration.



## Requirements

### Fluid Science - Plate Heat Exchanger - FS-3.4



The Fluid Science Plate Heat Exchanger tray includes experimentation to demonstrate indirect heating or cooling by transfer of heat from one fluid stream to another when separated by a solid wall (fluid to fluid heat transfer) in a plate heat exchanger.

The tray introduces students to concepts such as heat transfer coefficients, thermal resistances, controlling resistance and heat transfer driving forces. The heat exchanger can be used in a co-current or countercurrent configuration.



## Requirements

### Fluid Science - Fluidised Bed - FS-4.1



The Fluidised Bed tray introduces students to the concepts of bed fluidisation commonly encountered both in nature and in industry.

Natural occurrences include the movement of ground water, the movement of crude petroleum or the movement of natural gas through porous media.

Industrial occurrences include operations such as back-washing filters, ion-exchange processes, extraction of soluble components from raw materials and certain types of chemical reactor.





# Engineering Fundamentals

Link to EF Series



Part of a comprehensive range of engineering topic trainers

Provides students with a solid grounding in engineering fundamentals!

The EF series establishes the basis of Armfield's extensive range of engineering teaching and research equipment, for learning and discovery from Key Stage 4 through to undergraduate level.

PERFECT FOR THE FOLLOWING LEVELS

STEM

Vocational Training

High Schools & Technical Colleges

University Foundation Degrees



Watch video or search EF Series [armfield.co.uk](http://armfield.co.uk)



EF2-1 Dynamic Friction

EF1-3B Braced Pitched Portal

Experiments supplied in trays

Base Unit shown with EF-1.1 Statics Forces



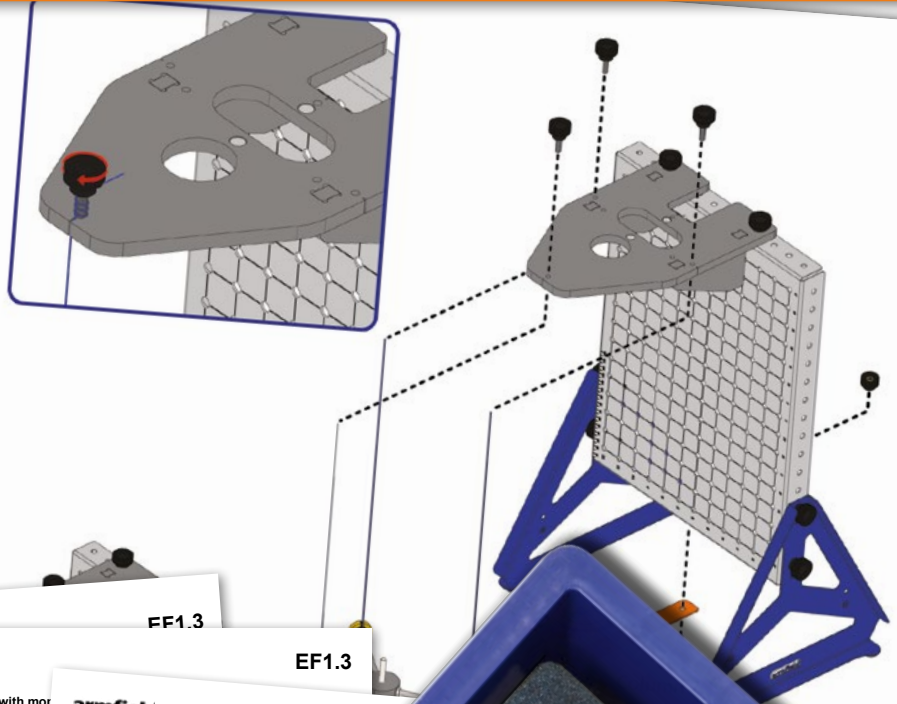
## EF Chapters / Topics / Experiments

The Modular, hands-on tray, based system is supplied in conjunction with a multifunctional Base Unit enabling the student to conduct their own experiments in subjects such as Statics, Dynamics and Kinematics.

Using easy to follow instructions experiments can be conducted individually or in front of a class.

Choose your topic, build and conduct experiments with our easy instructions and manuals, record the outcome!

- ▶ Simple graphical instructions enable the rapid assembly of all experiments
- ▶ Supplied with a detailed instruction manual, covering the theory of beams including multiple practical experiments designed to further develop the students' understanding in this field
- ▶ Hands on Learning



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### 1.2.3 Beam Load Conditions

As well as variations in end condition, the following examples of common loading types can be used:

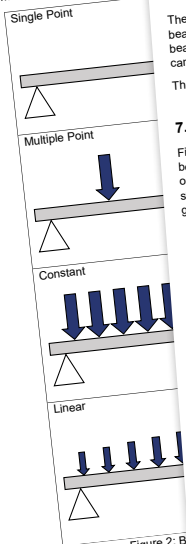


Figure 2: Beam loading conditions

PC-0060795

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### 7 Experiment 6

#### 7.1 Objective

The objective of this experiment is to compare the deflection of a single beam with that of a stacked beam. The beams will be compared under the following conditions:

#### 7.2 Basic Theory

Figure 21 shows how the deflection of a beam varies between the top and bottom of the beam. The deflection of a stacked beam is not greater.



Figure 21: Beam deflection

EF1.3

armfield

### 9.6.3 Beam loaded with moment

Figure 32 (below), represents the



Figure 32: Beam loaded with moment

The moment  $M$  will decrease along the length of the beam and is defined as:

$$M_x = \frac{Mx}{L}$$

And,

$$\frac{Mx}{LEI} = \frac{d^2\delta}{dx^2}$$

Integrating once will give the

$$\frac{d\delta}{dx} = \frac{Mx^2}{2LEI} + C_1$$

The slope will not be zero at the fixed end. For the slope to be zero in the centre. For the

$$\delta = \frac{Mx^3}{6LEI} + C_1x + C_2$$

We know the deflection at the fixed end is zero. For the

EF1.3

armfield

### 3 Experiment 2 (1.3.2): Two Point Load

#### 3.1 Objective

The objective of this experiment is to compare the deflection of a beam under the condition to simply supported and built-in.

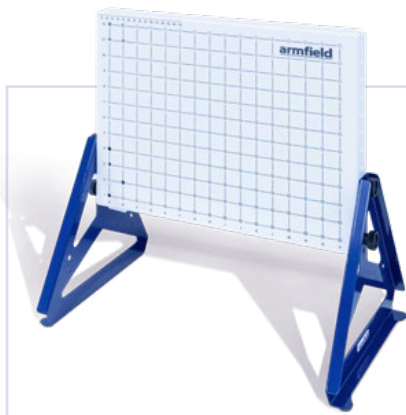
#### 3.2 Basic Theory

##### 3.2.1 Simply Supported Beam

Consider Figure 10, below. The beam represents a proportion of the length of the beam, the deflection is seen across a great length of the beam.

Beam represented by

## Engineering Fundamentals - EF Series



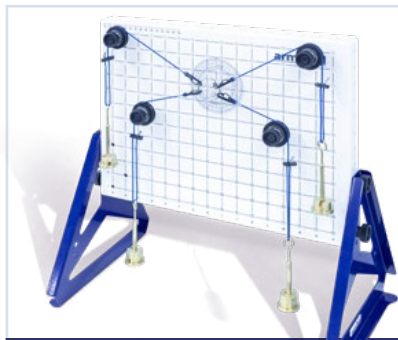
### Base Unit - EF-BU

The Base Unit is easy to set up with no assembly tools needed. The screen-printed design includes a measuring scale to ensure repeatable exercises.

The base unit can be set up horizontally, vertically and in inclined positions to suit experiment.



Requirements



### Statics / Forces - EF-1.1

The Forces experiment kit enables students to understand the centre of gravity of different shapes and analysis of forces in equilibrium for concurrent and non-concurrent force.

Requirements

EF-BU



### Statics / Moments - EF-1.2

The Moments experiment kit enables students to understand the relationship of weights and beam balance.

The different configuration is possible to enhance understanding of the principles of moments, levers, beams and the relationship of distance and forces applied on a beam.

Requirements

EF-BU



### Statics / Beams - EF-1.3a

The Beams experiment kit enables students to analyse the behaviour of different types of beams under a variety of load conditions.

Requirements

EF-BU



### Statics / Trusses - EF-1.3b

The statics Trusses experiment kit enables students to analyse the behaviour of different types of portal and truss frames.

Requirements

EF-BU





### Requirements

#### Statics / Springs - EF-1.4

EF-BU

The Springs experiment kit enables students to learn about Hooke's law when applied to both extension and compression springs. Students can experiment with a single spring, springs in series or in parallel. A variety of compression springs are included to enable students to learn about spring rates.



### Requirements

#### Statics / Torsion - EF-1.5

EF-BU

The Torsion experiment kit enables students to understand the relationship between torsion and the angle of twist for any given material.

The modular hands-on tray based system is supplied in conjunction with a multifunctional Base Unit enabling the student to conduct their own experiments in subjects such as Statics, Dynamics, Mechanisms and Kinematics.



### Requirements

#### Dynamics / Friction - EF-2.1

EF-BU

The Friction experiments kit enables students to understand that friction can be affected by a number of variables including material surface, mass of the object trying to slide, angle of sliding and what effect external forces acting on the object will have.

The kit is designed to help students understand that friction can be divided into 2 categories, static friction and kinetic (dynamic) friction.

The extent at which friction is reduced by using wheels and rollers, the angle at which the object slides and the angle of friction with the movement of an object along a plane is dependent on what external forces are applied and from which direction.



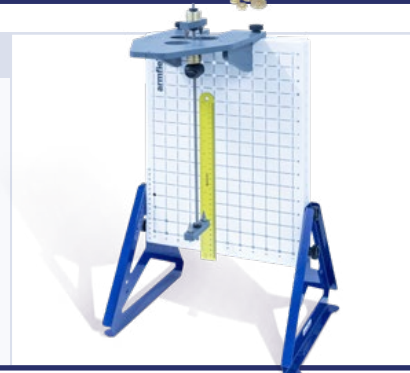
### Requirements

#### Dynamics / Simple Harmonic Motion - EF-2.2

EF-BU

The Simple Harmonic Motion (SHM) experiments kit enables students to understand the effect of mass and length of pendulum on SHM and the period of oscillation.

The relationship between SHM and gravity is evaluated using the Kater's pendulum, as well as understanding SHM in a mass spring system.



### Requirements

#### Dynamics / Rotational Friction - EF-2.3

EF-BU

The Rotational Friction experiments kit enables students to understand how rotational friction affects the efficiency of a screw jack, a wedge and different bearings.

The kit includes experiments that measure the effort required to raise various loads using a simple form of screw jack.

These include determining how the mechanical advantage and efficiency varies with load, the mechanical advantage and efficiency obtained by using two different wedges including investigating the effect of the angle on overhauling and to compare the resistance to rotation due to friction in four cantilevered bearings of different materials.





## Dynamics / Potential and Kinetic Energy - EF-2.4

The Potential and Kinetic Energy experiments kit enables students to understand the difference between potential and kinetic energy and how it can transform from one to the other.

The kit contains a flywheel, a pendulum and set of springs.

The kit will allow students to verify Hooke's law, teach them about energy transfer from potential to kinetic energy using a simple pendulum as well as using a flywheel to show the energy transfer from potential to kinetic and that it can be transferred back again via storage and release.

Requirements

EF-BU



## Dynamics / Centrifugal and Centripetal Force - EF-2.5

The Centrifugal and Centripetal Forces kit enables students to demonstrate the relationship between centrifugal force, radius and velocity of rotating masses.

Requirements

EF-BU



## Mechanisms / Cam, Crank and Toggle - EF-3.1

The Cam, Crank and Toggle experiments kit provides students with an introduction to cams and rollers and additionally crank motion and toggle.

The kit is designed to help students understand how cams are used, to show how the rotational motion of a cam is transmitted to the linear motion of a follower and how different shapes of cam can be used to achieve varying magnitude and duration of linear motion.

Similar to cams, a crank mechanism can transform rotational motion into linear motion although unlike cams, cranks can also work in the opposite direction, transferring linear motion into rotational motion.

Requirements

EF-BU



## Kinematics / Simple Mechanisms - EF-3.2

The Simple Mechanisms experiment kit enables students to visualise and understand the different types of mechanical systems and the conversion of linear motion to rotary motion and vice versa.

The modular hands-on tray based system is supplied in conjunction with a multifunctional Base Unit enabling the student to conduct their own experiments in subjects such as Statics, Dynamics, Mechanisms and Kinematics.

Requirements

EF-BU



## Mechanisms / Additional Mechanisms - EF-3.3

The Additional Mechanisms experiments kit provides students with an introduction to conversion of motion using a ratchet and Geneva mechanism.

The Geneva mechanism is a gear mechanism that translates a continuous rotational movement into intermittent indexed rotary motion, with accurately locked location of the driving component. Such mechanisms are frequently used in mechanical watches, film movie projectors and movie cameras.

A Ratchet mechanism allows for continuous linear or rotary motion in one direction while preventing movement in the opposing direction. Such mechanisms are widely used in machinery and tooling such as jacks, hoists, and socket wrenches.

Requirements

EF-BU





## Requirements

### Mechanisms / Bar Linkages - EF-3.4

EF-BU

The Bar Linkages experiments kit comprises of different perforated bars or links configured into a range of different linkage mechanisms, including four-bar linkages, rotary and linear movement and planar linkages allowing students to trace the relative movements of each linkage and joint.

A linkage is an assembly of links and joints that provide a desired output motion in response to a specified input motion. One such example and one of the simplest moveable closed-chain linkages is the four-bar which consists of four bars or links connected in a loop by four joints and can be used for many mechanical purposes, including converting rotational motion to reciprocating motion and converting reciprocating motion to rotational motion.



## Requirements

### Kinematics / Pulleys - EF-4.1

EF-BU

The Pulleys experiments kit introduces students to various types of pulleys including fixed, movable and compound pulleys. These experiments show the advantages of using different types of pulleys as a way of lifting weights.

The kit also allows students to familiarise themselves with a simple windlass or wheel and axle and how this can allow a large load to be lifted whilst still maintaining a mechanical advantage, a differential windlass, how a capstan device allows high loads to be controlled by a relatively low restraining force and a Weston differential or chain hoist.

The kit introduces students to terms such as mechanical advantage, velocity ratio, work done, efficiency and the laws of a machine.



## Requirements

### Kinematics / Gears - EF-4.2

EF-BU

The Gears kit includes a selection of gears to enable students to understand their unique advantages and characteristics.

This kit includes the following gears to allow students to test each set of gears and visualise their different characteristics:

- ▶ Spur gears
- ▶ Bevel gears
- ▶ Worm gears
- ▶ Gear systems
- ▶ Single gears
- ▶ Compound gears
- ▶ Idler gear
- ▶ Rack and pinion



## Requirements

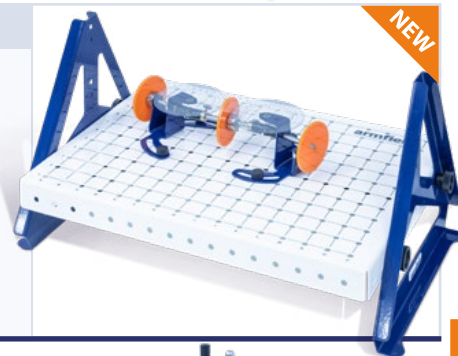
### Kinematics / Drive Systems - EF-4.3

EF-BU

The Drive Systems experiments kit introduces students to various types of belt, chain, and shaft drive systems.

Belt and chain drive experiments are included to demonstrate the characteristics of different systems with multiple velocity ratios. The efficiency can be calculated for varying loads for both the different velocity ratios and the different belt and chain systems allowing comparisons between the systems to be observed. Experiments are also included to demonstrate the effect of belt tension and the effect of pulley lap.

Experiments in universal couplings define how they should be set up to ensure that the rotational velocity from the input is seen at the output. The angle of each universal joint and the orientation relative to each other will be tested to see which setup will give uniform angular transmission.



## Requirements

### Tensile Tester - EF-5.1

EF-BU

The Tensile Tester apparatus is an addition to the EF range of accessories for Engineering Fundamentals.

Designed to demonstrate the tensile strength of test pieces of different materials.

This kit includes specimens of different materials. In addition to the destruction of a test specimen, the key relationship between force vs elongation can be easily determined and visualised by the students.



**EF**  
SERIES

# Engineering Fundamental Kits

## Bundled Education Solutions For Engineering Fundamentals

The modular hands-on tray-based system is supplied in conjunction with a multifunctional Base Unit enabling the student to conduct their own experiments in subjects such as Statics, Dynamics, Mechanisms, Kinematics, and Strength of Materials.

Bundled Learning For:  
STEM Education

National Vocational Qualifications

High Schools & Technical Colleges

University Foundation Degrees

EF Bundles Link



## EFK6 Complete Kit

### Engineering Fundamentals Complete Kit - EFK6

Requirements

Contains all of the Engineering Fundamentals kits, plus Ten Base Units.  
**Includes the following experiment trays:**

- |   |  |
|---|--|
| <b>EF-BU Base Unit</b> (X10)              | <b>EF-2.4</b> Potential and Kinetic Energy (X1)      |
| <b>EF1-SPARES</b> (X1)                    | <b>EF-2.5</b> Centrifugal and Centripetal Force (X1) |
| <b>EF-WS-18</b> Work Stations X2          | <b>EF-3.1</b> Cam, Crank and Toggle (X1)             |
| <b>EF-1.1</b> Forces (X1)                 | <b>EF-3.2</b> Simple Mechanisms (X1)                 |
| <b>EF-1.2</b> Moments (X1)                | <b>EF-3.3</b> Additional Mechanisms (X1)             |
| <b>EF-1.3a</b> Beams (X1)                 | <b>EF-3.4</b> Bar Linkages (X1)                      |
| <b>EF-1.3b</b> Trusses (X1)               | <b>EF-4.1</b> Pulley's (X1)                          |
| <b>EF-1.4</b> Springs (X1)                | <b>EF-4.2</b> Gear's (X1)                            |
| <b>EF-1.5</b> Torsion (X1)                | <b>EF-4.3</b> Drive Systems (X1)                     |
| <b>EF-2.1</b> Friction (X1)               | <b>EF-5.1</b> Tensile Tester (X1)                    |
| <b>EF-2.2</b> Simple Harmonic Motion (X1) |  |
| <b>EF-2.3</b> Rotational Friction (X1)    |  |



NEW

X10





<p>Requirements</p> 	<p><b>Forces and Moments Kit - EFK1</b></p> <p>Contains one of each of the Forces and Moments Kits, plus two Base Units.</p> <p><b>Includes the following experiment trays:</b></p> <p><b>EF-BU Base Unit</b> (X2)  <b>EF-1.1</b> Forces (X1)  <b>EF-1.2</b> Moments (X1)</p>	<p><b>EFK1</b> <span style="float: right;">NEW</span></p> <p>Forces and Moments Kit</p> 
<p>Requirements</p> 	<p><b>Materials Testing Kit - EFK2</b></p> <p>Contains one of each of the Deflection of Beams, Springs, Torsion and Tensile Tester Kits, plus four Base Units.</p> <p><b>Includes the following experiment trays:</b></p> <p><b>EF-BU Base Unit</b> (X4)  <b>EF-1.3a</b> Beams (X1)  <b>EF-1.4</b> Springs (X1)  <b>EF-1.5</b> Torsion (X1)  <b>EF-5.1</b> Tensile Tester (X1)</p>	<p><b>EFK2</b> <span style="float: right;">NEW</span></p> <p>Materials Testing Kit</p> 
<p>Requirements</p> 	<p><b>Forces and Moments Kit - EFK3</b></p> <p>Contains one of each of the Centrifugal Force, Pulleys, Gears and Drive Systems Kits, plus four Base Units.</p> <p><b>Includes the following experiment trays:</b></p> <p><b>EF-BU Base Unit</b> (X4)  <b>EF-2.5</b> Centrifugal and Centripetal Force (X1)  <b>EF-4.1</b> Pulley's (X1)  <b>EF-4.2</b> Gear's (X1)  <b>EF-4.3</b> Drive Systems (X1)</p>	<p><b>EFK3</b> <span style="float: right;">NEW</span></p> <p>Simple Machines Kit</p> 
<p>Requirements</p> 	<p><b>Forces and Moments Kit - EFK4</b></p> <p>Contains one of each of the Cam, Crank and Toggle, Simple Mechanisms, Additional Mechanisms and Bar Linkages Kits, plus four Base Units.</p> <p><b>Includes the following experiment trays:</b></p> <p><b>EF-BU Base Unit</b> (X4)  <b>EF-3.1</b> Cam, Crank and Toggle (X1)  <b>EF-3.2</b> Simple Mechanisms (X1)  <b>EF-3.3</b> Additional Mechanisms (X1)  <b>EF-3.4</b> Bar Linkages (X1)</p>	<p><b>EFK4</b> <span style="float: right;">NEW</span></p> <p>Mechanisms Kit</p> 
<p>Requirements</p> 	<p><b>Forces and Moments Kit - EFK5</b></p> <p>Contains one of each of the Friction, Simple Harmonic Motion, Rotational Friction and Potential and Kinetic Energy Kits, plus four Base Units.</p> <p><b>Includes the following experiment trays:</b></p> <p><b>EF-BU Base Unit</b> (X4)  <b>EF-2.1</b> Friction (X1)  <b>EF-2.2</b> Simple Harmonic Motion (X1)  <b>EF-2.3</b> Rotational Friction (X1)  <b>EF-2.4</b> Potential and Kinetic Energy (X1)</p>	<p><b>EFK5</b> <span style="float: right;">NEW</span></p> <p>Vibration, Friction and Energy</p> 



# Renewable Energy



Part of a comprehensive range of renewable energy studies

The Engineering Fundamentals (EF) renewable energy range is designed specifically for the High school and Technical college Curricula.



EF-6.3 - Anemometer



NEW

## Photovoltaic Energy kit - EF-6.1

Requirements

Covers the principles of Photovoltaics (PV) and the direct conversion of light into electrical energy through solar cells. The modular tray based kit is supplied with a plug and play base unit which allows the students to create a variety of supplied experiments.

EF-6.8

### Related Curricula:

- ▶ Physics
- ▶ Electrical Engineering
- ▶ Renewable Energies



NEW

## Wind Energy kit - EF-6.2

Requirements

Covers the principles of wind power generation. This allows students to understand the functions of wind power plants. Including practical experiments into how wind speed, wind direction or rotor type influences the power output.

EF-6.3

EF-6.8

### Related Curricula:

- ▶ Physics
- ▶ Electrical Engineering
- ▶ Renewable Energies





## Requirements

### Hydrogen Fuel Cell Technology - EF-6.4

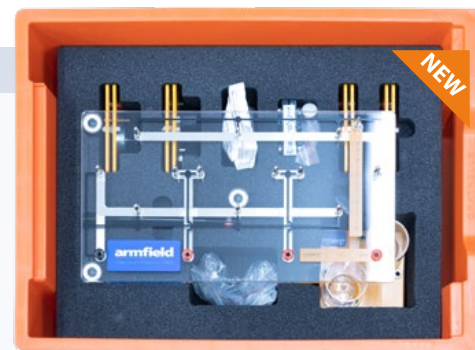
EF-6.8

The kit covers the principles of electrolysis and fuel cells. Containing PEM-fuel cells and the components of a complete solar-hydrogen cycle (electrolyzer, PEM fuel cell and solar module). The electrical consumer (motor) allows for realistic and demonstrative experiments.

*Can be optionally expanded with an SOFC cell to demonstrate a second fuel cell technology.*

**Related Curricula:**

- ▶ Physics, Chemistry, Electrical Engineering, Renewable Energies



## Requirements

### Biomass Fuel Technology - EF-6.5

EF-6.8



Covering the entire process of producing biofuels. It starts with the biological step of alcoholic fermentation. Afterwards the produced mash will be distilled with the help of the supplied condenser.

The final stage is the conversion of the produced biofuel into usable energy, such as electrical energy, using the provided Ethanol-fuel cell.

*The tray additionally covers production of biodiesel through transesterification of fats.*

**Related Curricula:**

- ▶ Physics, Chemistry, Biology, Electrical Engineering, Renewable Energies



## Requirements

### Battery Technology Kit - EF-6.6

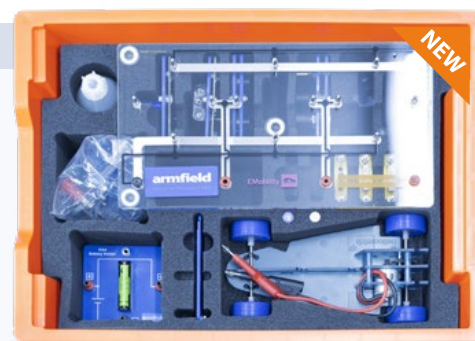
EF-6.8

The kit teaches students the physical and technical principles and applications of different battery technologies. The highly topical issue of electric mobility is explored with an electric model car.

*The characteristics of various battery types are analyzed with qualitative and quantitative experiments.*

**Related Curricula:**

- ▶ Physics
- ▶ Electrical Engineering
- ▶ Renewable Energies



## Requirements

### Renewable Energy - EF-6.7

EF-6.8

The Renewable Energies kit has been specifically adapted for basic introduction to photovoltaic, wind power, hydro power, battery and fuel cells technology.

*The kit is supplied with all accessories including power supply, cables and measuring devices.*

**Related Curricula:**

- ▶ Physics
- ▶ Chemistry
- ▶ Electrical Engineering
- ▶ Renewable Energies



## Requirements

### Accessories Kit - EF-6.8

EF-6.8

The Accessories Kit comprises of all the essential items required by students to operate the engineering fundamentals renewable energy kits.

**Supplied in a modular tray the kits include:**

- ▶ Power Module's
- ▶ Power supply's
- ▶ Test leads
- ▶ Digital multi meters
- ▶ A light source
- ▶ An anemometer
- ▶ Laboratory thermometer



## Renewable Energy - RE Series

**RE**  
SERIES

# Renewable Energies Range



A suite of specialised learning systems for technical education in universities and vocational training centres and technical colleges.

The advanced renewable energy series encompasses the following new energies technologies:

- ▶ Photo-voltaic Energy
- ▶ Wind Energy
- ▶ Fuel cell Technology
- ▶ Thermal Energy
- ▶ Wind Energy
- ▶ Smart Grid Technology
- ▶ Energy Efficiency & Saving
- ▶ Bio Fuel
- ▶ Bio Energy
- ▶ Battery Technology
- ▶ Renewable Energy
- ▶ Hydro-power



RE10 - Advanced Photovoltaic Energy



RE12 - Advanced Wind Energy



RE14 - Advanced Fuel Cell Technology



RE16 - Advanced Thermal Energy



RE18 - Advanced Smart Grid Technology



RE20 - Biofuel



RE22 - Advanced BioEnergy



RE24 - Advanced Battery Technology

The kits are supplied including all the necessary ancillary and measuring equipment, student and teacher instructions and are supplied in a custom designed aluminium case with heavy-duty foam inserts.



Requirements

## Advanced Photovoltaic Energy - RE10

1Ph

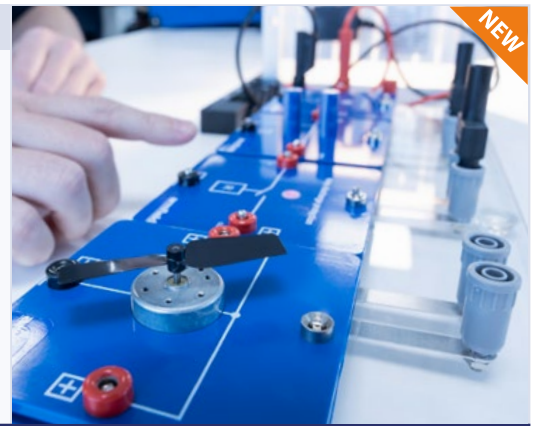
The case provides students with a self-contained modular system, covering the physical fundamentals of photovoltaics, the analysis of the components of PV-Systems, and the ability to design.

**Experimental Content:**

- ▶ Electrical engineering basic experiments
- ▶ Photovoltaic basic experiments
- ▶ Photovoltaic system experiments

**Related Curricula:**

- ▶ Electrical Engineering
- ▶ Renewable Energies



Requirements

## Advanced Wind Energy - RE12

1Ph

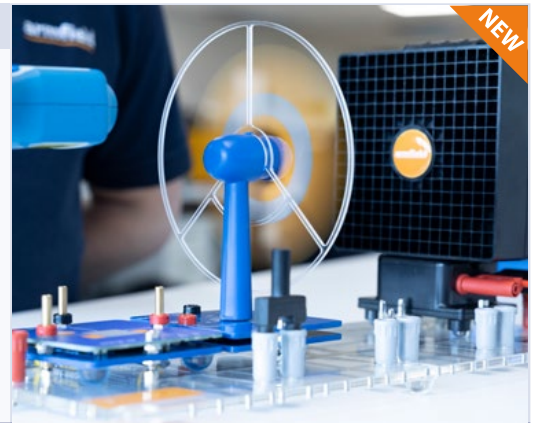
The case provides students with a self-contained modular system, covering the physical fundamentals of wind energy productions, covering wind power fundamentals, controlling a typical wind tunnel and different rotor types.

**Experimental Content:**

- ▶ Basic electronic experiments
- ▶ Basic wind experiments
- ▶ Influence of a consumer

**Related Curricula:**

- ▶ Electrical Engineering
- ▶ Renewable Energies



Requirements

## Advanced Fuel Cell Technology - RE14

1Ph

The case provides students with a self-contained modular system, covering current fuel cell technology on a laboratory scale. Using the system students can undertake experiments covering working principles, efficiency, and characteristics curves of electrolysers and fuel cells. In addition to a PEM-fuel cell, it also contains an ethanol-fuel cell to compare the different technologies.

**Related Curricula:**

- ▶ Chemical Engineering
- ▶ Electrical Engineering
- ▶ Renewable Energies



Requirements

## Advanced Thermal Energy - RE16

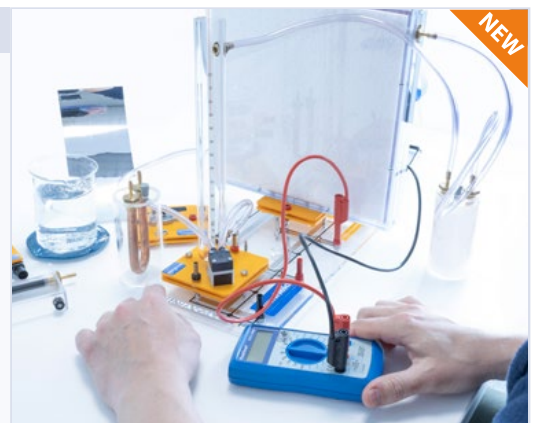
1Ph

The case provides students with a self-contained modular system, covering the different technologies for solar thermal energy transformation on a laboratory scale. Included in the system are various solar collector systems (including Parabolic reflector and Absorber tube) which can be operated with or without the supplied pump.

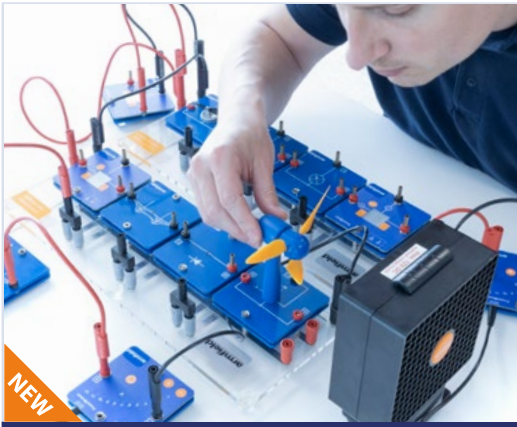
Additionally supplied are CSP-technology (Concentrated Solar Power) and a Peltier element for the direct transformation into electric energy.

**Related Curricula:**

- ▶ Renewable Energies
- ▶ Air-conditioning
- ▶ Heating
- ▶ Energy Efficiency



# Renewable Energy - RE Series



## Advanced Smart Grid Technology - RE18

The case provides students with a self-contained modular system, allowing an in-depth understanding of the complex interactions between renewable energies, energy storage and consumers on a laboratory scale.

### Experimental Content:

- ▶ Smart grid experiments
- ▶ Fundamental experiments in: **Photovoltaics / Wind energy / Fuel cell and electrolyzer / Storage technologies**

### Related Curricula:

- ▶ Electrical Engineering
- ▶ Renewable Energies

Requirements



## Advanced Biofuel - RE20

The case provides the entire process of producing biofuel is demonstrated with the Armfield Bio-Fuel kit in the form of student experiments. The suitcase contains all necessary parts and components and can be used from any location. Our first step is resource selection and fermentation. The resulting mash is then distilled with the custom-built condenser and the resulting ethanol will be characterized.

Lastly, the produced bio fuel needs to be converted into usable energy – for example into electricity with the provided ethanol fuel cell.

### Related Curricula:

- ▶ Electrical Engineering
- ▶ Chemical Engineering
- ▶ Environmental Engineering

Requirements



## Advanced BioEnergy - RE22

The extensive experiment system brought to you by the Armfield BioEnergy kit enables you to reconstruct and understand the whole biomass cycle without any additional equipment.

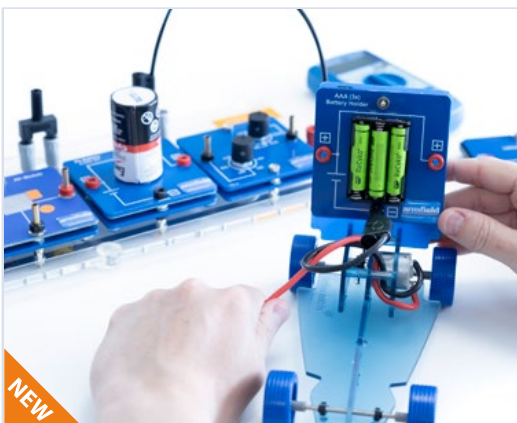
### Experimental Content: BioEnergy experiments

- ▶ Germination of plant seeds
- ▶ Plant growth in a hydroculture
- ▶ Consumption of water and nutrients
- ▶ Aerobic degradation of biomass in a compost
- ▶ Anaerobic degradation of biomass to form hydrogen
- ▶ Anaerobic degradation of biomass to form methane

### Related Curricula:

Renewable Energies, Chemical Engineering, Environmental Engineering

Requirements



## Advanced Battery Technology - RE24

Provides a comprehensive experimentation system for battery technology.

With the equipment students will fully understand which battery technologies is required and how this decision is made based on capacity, loading and durability.

The kit is supplied with different battery technologies such as lead, NiMH, or Lithium-Polymer (LiPo) as well as a PEM-fuel cell.

### Related Curricula:

- ▶ Renewable Energies
- ▶ Electrical Engineering
- ▶ Automotive Engineering

Requirements



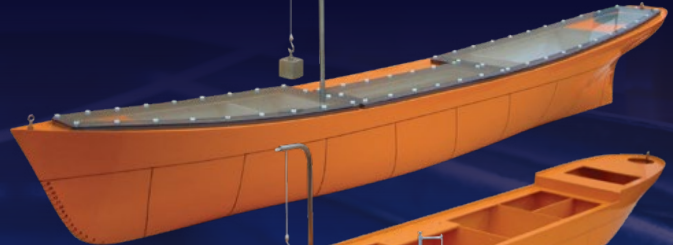




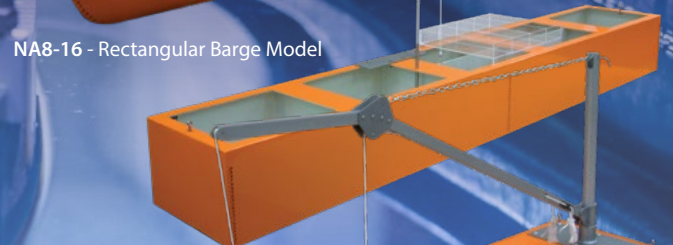
# Naval Architecture

The Armfield Naval Architecture range provides in-depth studies into fluid mechanics relating to Ship Science. Subjects covered include ship resonant vibration, distribution of mass and second moment of area, ship hydrostatics and ship stability.

Supplied - 1/70 scale model of a 28000 tonne general cargo vessel

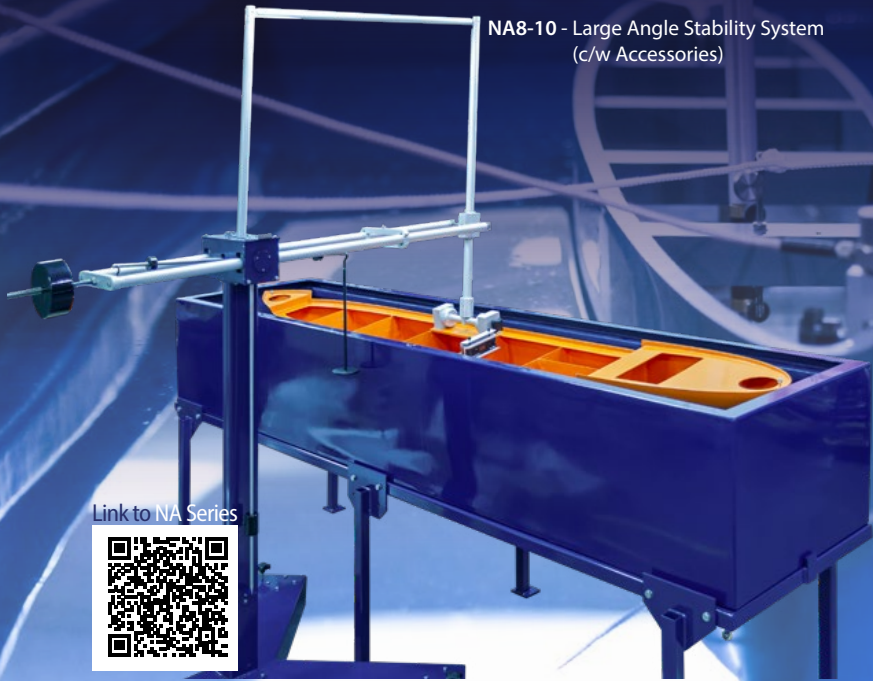


NA8-14 - Trawler Model



NA8-16 - Rectangular Barge Model

NA8-15 - Crane Ship Model



NA8-10 - Large Angle Stability System (c/w Accessories)

[Link to NA Series](#)



Requirements

### Ships Vibration Apparatus - NA4

1Ph

NA 4-11

The apparatus is designed to enable an investigation of a simple model hull form enabling many of the principal phenomena connected with ship resonant vibration to be clearly demonstrated.

At a more advanced level, the distribution of mass and second moment of area may be calculated and natural frequencies estimated/compared with measured values.

**Flotation Tank - NA4-11** (Recommended option shown in product picture)



Requirements

### Ships Stability Apparatus - NA8

1Ph

NA 4-11

Developed for the laboratory study of ship hydrostatics and stability.

The complete apparatus comprises four different types of vessel models with ballast weights, clinometer and a water tank in which to float them. Righting moment is measured by a free-standing dynamometer.

**NA4-10** Ships Vibrations Test Model

**NA4-11** Flotation Tank for NA4-10

**NA8-10** Large Angle Stability System (c/w Accessories)

**NA8-14** Trawler Model

**NA8-15** Crane Ship Model

**NA8-16** Rectangular Barge Model





# Control & Acquisition Systems

Link to armSOFT



# armSOFT

armSOFT data entry, data logging, acquisition and control software

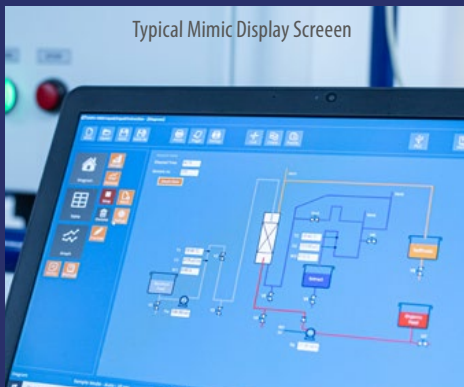


Typical armSOFT aSUITE Controller Screen

Available for many Armfield products, with a wide range of features

- ▶ Remote access
- ▶ Remote control
- ▶ Data logging
- ▶ Realtime display
- ▶ Graph plotting
- ▶ Process results
- ▶ Export results to Excel
- ▶ Manual & automatic data entry
- ▶ Spreadsheet format
- ▶ Mimic diagrams
- ▶ Graphs
- ▶ Controller screen
- ▶ Intuitive interface
- ▶ Online help available
- ▶ Comes standard with many items

Typical Mimic Display Screen



Typical Tabular Display



Typical armSOFT graphical screen





The armSOFT™ suite of software from Armfield delivers an intuitive and simple to use range of computer applications. The user interface is generic across the range providing powerful data entry, data logging, acquisition and control software with a wide range of features which is available for many Armfield products.

Requirements

**Manual Data Entry - aBASIC**

- PC
- USB

Some products are not suitable for data logging, and require the results to be input manually from primary instrumentation such as manometers or thermometers.

For these products the armSOFT aBASIC software offers a powerful tool for displaying and processing the results.

**aBASIC**



Requirements

**Data logging Facilities - aLITE**

- PC
- USB

Powerful data logging software with automatic or manual sampling. The data is stored in spreadsheet format, which also contains any calculated values.

The software includes powerful graph plotting tools enabling numerous display options, including dual y axes, points or lines.

**aLITE**



Requirements

**Acquisition and Control - aSUITE**

- PC
- USB

This package has all the data logging and general features of the armSOFT aLITE package, but also includes computer control.

A mimic diagram is used where set points and output values can be specified, PID loops can be tuned, and on-off switches can be controlled.

**aSUITE**



PID Control screen

**Hardware**

armSOFT data logging products connect to the computer using USB interfaces. The USB interface is either built into the main equipment or via a separate control unit such as the IFD7.

The interface details can be seen in the requirements section for each individual product, to utilise the USB interface a computer is essential.



# Hardware/Software Control & Acquisition Systems

Link to armBUS



# armBUS

A revolutionary integrated hardware/software ecosystem, enabling the connection of teaching and research equipment to the modern world

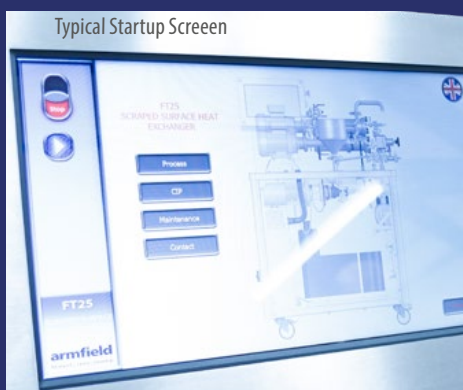
The armBUS standardised interface makes operating Armfield products easy for teaching and research, producing reliable data or product across multiple area's of industry.



armBUS a radical system for integrating electronic measurement sensors and control devices onto teaching and research equipment. armBUS is a universal, single-wire interface which enables all peripheral sensors and control mechanisms to be connected to a digital bus with common ports. Connectivity is completely port independent, eliminating errors in the configuration of the system as well as enabling seamless integration of new sensors at any point in time.

armBUS can be interfaced to a variety of devices via a USB port, network port or wireless connection enabling the equipment to be operated with a PC, PC with touchscreen, optional LCD touchscreen or a mobile device such as a tablet.

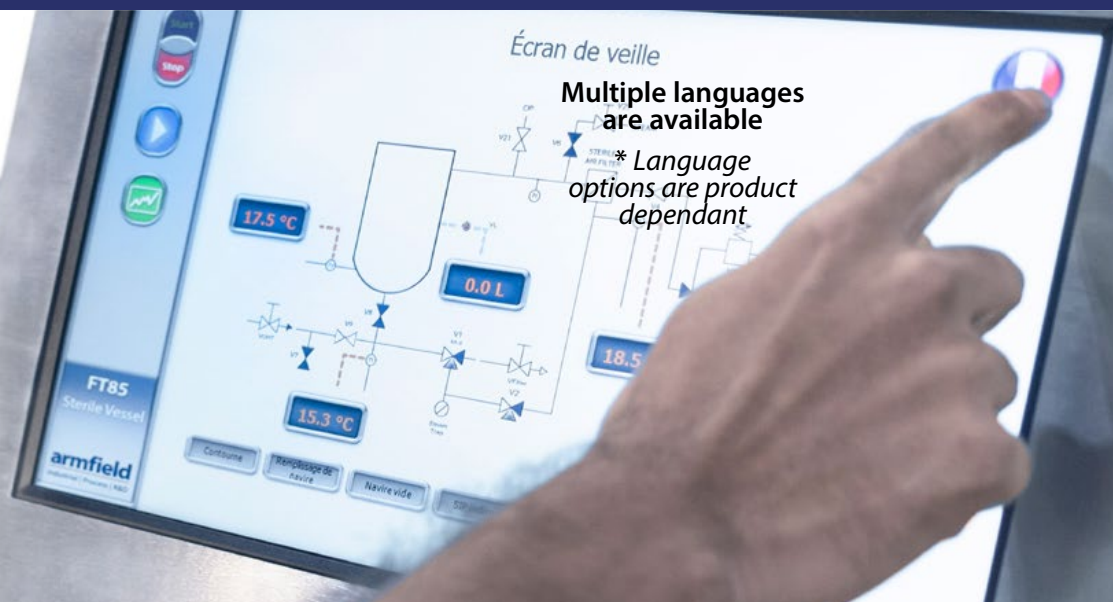
Advantages of the armBUS system include improved reliability, improved interchangeability and improved accuracy. All sensors are pre-calibrated, eliminating the need for further calibration after installation or if a sensor is replaced.





Standard controls for all basic functions such as start-up & shut down

Data logging as standard, results can be analysed in armBUS or exported to a spreadsheet



**Requirements**

- PC
- USB

**Hardware Acquisition and Control - armBUS TH6**

TH6 Film and Dropwise Condensation Demonstration Unit

- ▶ Total control and monitoring of process parameters
- ▶ Can view trends in current parameters
- ▶ Comparison of current data to previous process runs possible in real time
- ▶ Quick save feature for data recovery

**Requirements**

- PC
- USB

**Hardware Acquisition and Control - armBUS FT74XA**

FT74XA Miniature-scale HTST/UHT processing system

- ▶ Total control and monitoring of process parameters
- ▶ Can view trends in current parameters
- ▶ Comparison of current data to previous process runs possible in real time
- ▶ Quick save feature for data recovery

**Requirements**

- PC
- USB

**Hardware Acquisition and Control - armBUS UOP30**

UOP30 3-Phase Horizontal Separator

- ▶ 3-Phase horizontal separator
- ▶ Visual demonstration of the entire separation process
- ▶ Software Control, PID and data logging via PC

# **armfield**

## Industrial Processing & Food Technology

Link to IFT Series



Research | Development | Production | Industry

Armfield can provide a complete solution to your requirements, offering not just the equipment but processing line advice, planning, installation, commissioning and training.

This range includes industry rated equipment for vocational training, research and development, small scale pilot and batch production for applications in the following fields:

- ▶ Dairy
- ▶ Ingredients
- ▶ Flavours & fragrances
- ▶ Edible & essential oils
- ▶ Liquid foods
- ▶ Beverages
- ▶ Cosmetics
- ▶ Pharmaceuticals
- ▶ Nutraceuticals





Products listed by process

<b>Batch Heat Treatment/Pasteurisation</b>
<a href="#">FT19</a> <a href="#">FT140</a> <a href="#">FT141</a> <a href="#">FT142</a>
<b>HTST/UHT Thermal Processing</b>
<a href="#">FT43</a> <a href="#">FT75</a> <a href="#">FT84</a> <a href="#">FT94X</a> <a href="#">FT94LT</a> <a href="#">FT174X</a> <a href="#">FT74XA</a>
<b>Homogenisation</b>
<a href="#">FT90</a> <a href="#">FT91</a>
<b>Filling + Storage</b>
<a href="#">FT83</a> <a href="#">FT85</a>
<b>Carbonation/Filling/Capping</b>
<a href="#">FT102XA</a>
<b>Deaeration</b>
<a href="#">FT51</a>
<b>Drying</b>
<a href="#">FT30</a> <a href="#">FT31</a> <a href="#">FT32</a> <a href="#">FT33</a> <a href="#">FT80/81</a> (Also has chilling capability) <a href="#">UOP8MKIIe</a>
<b>Margarine Crystallisation</b>
<a href="#">FT21</a> <a href="#">FT25X</a> (20 & 40 bar Units)
<b>Ice Cream Processing</b>
<a href="#">FT25X</a> <a href="#">FT140X</a>
<b>CIP (clean in place)</b>
<a href="#">FT52</a>
<b>Mixing</b>
<a href="#">FT140X</a> <a href="#">FT141</a> <a href="#">FT142</a> (UHT capability)
<b>Filtration</b> - Microfiltration/Ultrafiltration/Nanonfiltration & Reverse Osmosis
<a href="#">FT18-MKII</a> - Different membranes available <a href="#">FT17</a> - Different membranes available
<b>Chilling</b>
<a href="#">FT63</a> or <a href="#">FT64</a>

<b>Pressure Extraction</b>
<a href="#">FT2</a> <a href="#">FT14</a> <a href="#">FT28</a> <a href="#">FT110DP</a> - 1 litre <a href="#">FT111X</a> - 5, 10 & 20 litres available
<b>Solvent Extraction</b>
<a href="#">FT29</a>
<b>Oil Neutralisation, Washing, Bleaching and Refining</b>
<a href="#">FT27</a> <a href="#">FT66</a>
<b>Oil Deodorisation</b>
<a href="#">FT68</a>
<b>Hydrogenation</b>
<a href="#">FT67</a>
<b>Cheese Making</b>
<a href="#">FT20</a>
<b>Freezing</b>
<a href="#">FT34</a> <a href="#">FT36</a>

**STERILE PROCESSING LINES**

<b>HTST/UHT System Options</b>
<a href="#">FT74XA</a> - Plate + Tubular heat exchanger <a href="#">FT174X</a> - Plate, Tube, Scraped surface H.E. + DSI <a href="#">FT94X</a> - Up to 200l/h (option) <a href="#">FT94LT</a> - Up to 100l/h
<b>Homogeniser Options</b>
<a href="#">FT90</a> or <a href="#">FT91</a>
<b>Mixing Tanks</b>
<a href="#">FT140X</a> - Various sizes and configurations available
<b>Sterile Filling Station/Storage</b>
<a href="#">FT83</a> - Optional UV <a href="#">FT85</a>
<b>Chiller Options</b>
<a href="#">FT63</a> or <a href="#">FT64</a>
<b>Steam Generator</b>
<a href="#">UOP10</a>



# Laboratory Pasteurisation

Link to IFT Dairy



The HTST/UHT processing equipment from Armfield allows you to create a modular heat treatment process line that can be reconfigured at any time.

From mixing and preparing the ingredients, through heat treating the product, storing it safely and filling it in a sterile environment, our equipment can safely simulate your processing needs.



FT140X Mixing Vessel



FT174X Modular Miniature Scale HTST/UHT Process System



FT63 Laboratory Process Chiller



FT85 Sterile Vessel



UOP10 Laboratory Steam Generator



FT83 Sterile Filling System



### The FT174X is a modular HTST/UHT processing system designed to treat products at flow rates of 10-40 l/h or up to 60 l/h for water (or similar low viscosity products)

Standard modules for direct heating (steam injection) or indirect heating (using tubular and/or plate heat exchangers), SSHE, aseptic processing, upstream or downstream homogenisation and additional chilling are available.

The touch-screen control panel makes it extremely user friendly and easy to configure and monitor processing parameters.

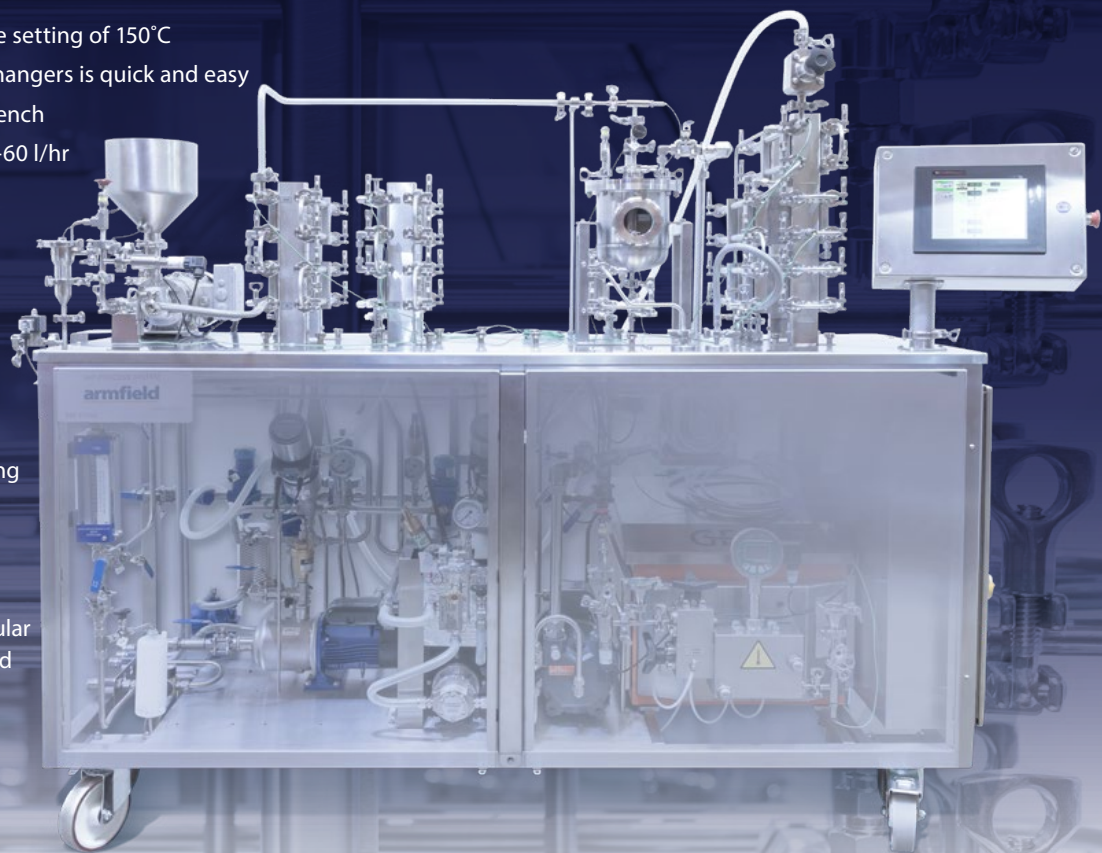
The operator is prompted at every stage whenever intervention is required.

- ▶ High degree of user configuration
- ▶ Rapid start-up and shut down
- ▶ Maximum product temperature setting of 150°C
- ▶ Switch-over between heat exchangers is quick and easy
- ▶ Links directly to sterile filling bench
- ▶ Standard throughputs from 10-60 l/hr
- ▶ Direct and/or indirect heating
- ▶ Low product hold-up
- ▶ Totally modular system
- ▶ Full sterile capability options
- ▶ Touchscreen control panel
- ▶ Hygienic fittings as standard
- ▶ Integral homogeniser option
- ▶ Controllable preheat and cooling
- ▶ Built-in CIP facility
- ▶ USB data logging option
- ▶ Electronic flow meter option
- ▶ Small footprint can contain tubular & plate heat exchangers, scraped surface heat exchangers (SSHE), DSI module & homogeniser

These, along with many other options, enable multiple modules to be included in the same system, giving high process adaptability by reconfiguration of flexible product hoses, using quick-release connections.

The sterilisation options enable it to be linked to an Armfield sterile filling bench to produce sterile product, even when using long holding tubes and/or downstream homogenisation.

*Options for increasing the automation of different sections are available.*



Link to FT174X



#### Requirements



#### Modular Miniature-Scale HTST/UHT Process System - FT174X

Indirect and direct processing using plate, tubular and scraped surface heat exchangers as well as DSI (or any combination).

The system is capable of SIP and CIP and optional in line homogenisation for use upstream or downstream.

- ▶ Flow rates between 10-60 l/h
- ▶ Multiple option are available to enhance your processing requirements

Can be linked to **FT83 Sterile Filler** for ESL products





## Industrial Processing & Food Technology

Link to FT74XA



The FT74XA is compact, mobile and easy to install. It has an integral pressurised hot water generator and requires only electricity and cooling water to operate making it ideal for confined spaces with limited services available.

Operation with either plate or tubular heat exchangers means a wide range of product viscosities can be handled.

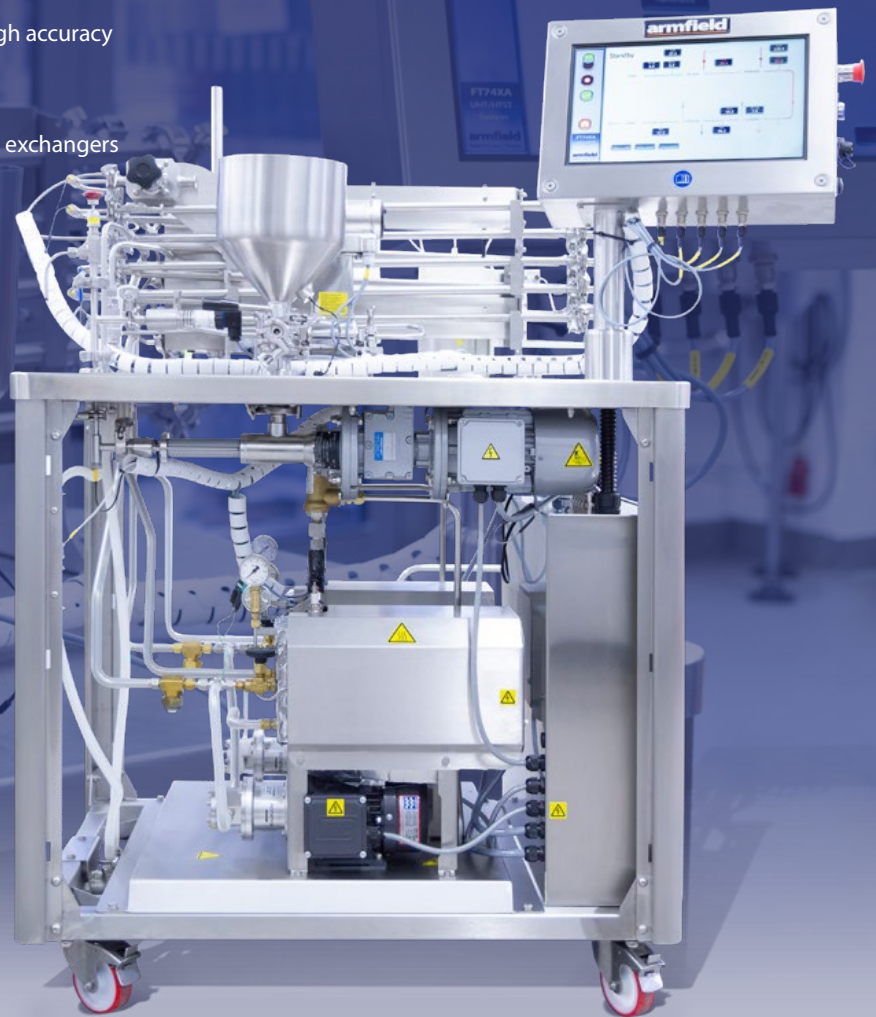
A progressive cavity feed pump ensures that flow rates are independent of viscosity/backpressure changes and allow a maximum operating pressure of 10 bar.

Typical processing flow rates are 10-20 L/h with holding temperatures up to 150°C.

- ▶ Platinum resistance (PT100) temperature sensors for high accuracy
- ▶ Variable holding tube options
- ▶ Fully instrumented: product pressure and flowrate
- ▶ Two-stage cooling capability for plate and tubular heat exchangers
- ▶ Rapid switch-over between heat exchanger types
- ▶ Tests can be made with a few litres of product
- ▶ Suction feed capability to operate in conjunction with an external feed tank
- ▶ Independent operation or within a continuous process in both aseptic and non-aseptic modes
- ▶ Automated SIP capability
- ▶ Touchscreen control of all operations
- ▶ Independent pre-heat hot water loop and product temperature control
- ▶ Seamless homogenisation integration upstream or downstream with automatic speed control through the touchscreen
- ▶ Recipes saved in the system for instant set-up of operating parameters for particular products
- ▶ Backpressure control using a sprung diaphragm valve or pinch valve for products containing particulates
- ▶ Controlled cooling
- ▶ On-screen calculation of holding times from flow meter reading and display of Fo value based on holding time and temperature

At pasteurisation temperatures flow rates of up to 60 L/h are achievable.

Cleaning in place (CIP) utilises the feed pump in high flow rate mode and there is a centrifugal pump CIP option FT74XA-52 which generates very high cleaning velocities to deal with products that are particularly difficult to clean.



### HTST/UHT System - FT74XA

The FT74XA is a highly flexible, miniature-scale HTST/UHT processing system which makes it ideal for new liquid product development.

It has a wide range of options to suit all needs and can be operated independently or as part of a continuous-operation process with other Armfield equipment.

- ▶ Platinum resistance temperature sensors for high accuracy
- ▶ Touchscreen control of all operations
- ▶ Two-stage cooling capability for plate and tubular heat exchangers
- ▶ armBUS control/instrumentation system increases reliability

#### Requirements





## Requirements

### HTST/UHT Mini Pilot System - FT94X

The Armfield FT94X HTST/UHT Mini Pilot system extends the range of continuous operation scaled-down units offered by Armfield to 30-100 l/h.

The unit combines full flexibility – plate and tubular heat exchanger options - with comprehensive instrumentation demanded of research and development equipment.

Options up to 200 l/h can be provided on special request.

See **FT64** for suitable chiller



## Requirements

### HTST/UHT Mini Pilot System - FT94LT

FT94LT is a cost effective HTST/UHT processing system, capable of throughputs of 30-100 l/h and process temperatures up to 150°C with a range of options, to tailor the product to your requirements.

Designed with flexibility in mind, the FT94LT Mini Pilot System is suitable for a wide range of applications, from fruit juices to ice cream, and pet food to pharmaceuticals.

See **FT64** for suitable chiller



## Requirements

### Sterile Vessel - FT85

The Armfield FT85 Sterile Vessel can store UHT processed product for sterile filling at a later point. It eliminates product wastage associated with pilot-scale continuous operation filling systems that lack buffering capacity.

The vessel is sited between Armfield's UHT processing units and the FT83 Sterile Filling System and is available with a 30L vessel (other sizes are available as a special request).

It is designed for operation with Armfield systems, but can be operated with other equipment.

Optional Steam Generator **FT85-10** removes the need for a steam supply for sterilisation.





## Microwave UHT Add-On - FT84

The Armfield Microwave UHT /HTST unit has been developed for the rapid heating of various types of viscous, nonviscous and even nonhomogeneous products.

Product temperatures up to 160°C can be reached. The product is heated in a short product tube enabling extremely rapid heating rates to be achieved.

The add-on unit is designed to be used in conjunction with the FT74XA, FT174X or FT94X, FT94LT UHT systems.

### Requirements



## Sterile Filling System - FT83

The Armfield FT83 is the most cost-effective solution for R&D departments to produce sterile packaged samples with an excellent shelf life.

As well as a working chamber with a controlled, clean environment, the unit includes the facilities to enable all the product paths to be sterilised and for the filling to be controlled in a simple manner.

A nitrogen nozzle is included, which can be directed over the container while filling, to give low oxygen content in the packaged product. N<sub>2</sub> is supplied via a sterile filter.

- ▶ Integrated UV lamp option is available for increased environment sterility

### Requirements



## Continuous In-line Deaerator - FT51

The Armfield FT51 deaerator unit has been designed to mirror the industrial processes of vacuum deaeration.

This unit enables small quantities of food and other liquid products to be processed conveniently in the laboratory it can be used in batch mode or in series with Armfield Thermal Processing Systems.

- ▶ N<sub>2</sub> gas can be introduced into the product in order to reach lower DO<sub>2</sub> levels (down to 0.5ppm)

### Requirements





## Requirements

### Homogenisation Sub-Systems - FT90/91



The FT90 and FT91 are complete in-line homogenisation sub-systems for use with Armfield miniature-scale food processing equipment.

The **FT90** is based on an APV LAB 1000 homogeniser and the **FT91** is based on a Niro Twin Panda.

Both homogenisers have been specifically optimised for this application.

- ▶ Can be operated upstream or downstream of HTST/UHT process or stand alone



## Requirements

### Multifunction Laboratory Mixer - FT141 Multifunction Laboratory Mixer UHT - FT142



The FT141 & FT142 offer flexible solutions to batch processing in the food laboratory. Requiring only small quantities of product, the systems provide results representative of large-scale industrial processes available in 10 or 20 litre sizes.

Ideal for R&D, the systems are suitable for high shear mixing, dispersing, homogenising, emulsifying, evaporation and vacuum deaerating.

The FT141 is capable of processing at 95% vacuum and up to 100°C, with the FT142 extending performance into UHT processing at up to 140°C and three bar pressure.



## Requirements

### Mixing Vessels- FT140X



Armfield FT140 Multipurpose Mixing Vessels are designed and constructed using high quality hygienic industry standard materials. These tanks are available in three models in varying configurations (see table) and are available in 50l and 100l volumes.

All three models have an internal surface made of AISI 316 stainless steel. Available with or without heating / high shear emulsifier.

Options are available with Colour Touch Screen and PLC control enables easy operation of stored recipes.



## Requirements

### Cheese Vat - FT20



A stainless steel jacketed vat for the production of cheese by the traditional method. A separate electrical console provides control of paddle agitator speed, temperature and pH indication.

Now offered in 10 litre or 20 litre variants: FT20-10 / FT20-20

- ▶ FT20A Cheese Making Accessories





# Oil Preparation & Processing

Armfield is proud of its unique oils preparation and refining line of processing equipment. Using this equipment, you can take a raw seed from the plant, extract the oil and refine it to the purity you desire.

These units can create oils that are ready for sale or further downstream processing in various forms depending on your requirement.



**FT29** Batch Solvent Extraction & Desolventising Unit



**UOP10** Laboratory Steam Generator



**FT66** Neutraliser/Washer/Bleacher



**FT68** Deodorising Unit



**FT67** Hydrogenation Unit



**FT25** Margarine Crystalliser



Edible oils have such a wide variety of forms and functions and are used in such a range of consumer products that constant redeveloping of new products and refining of the manufacturing process is becoming more of a necessity in modern manufacturing environment.



Link to FT25



The FT25 range of miniature-scale scraped surface heat exchangers has built-in control and flexibility with a graphic representation of the process on the touch screen control panel.

The operator can choose the parameters required for any particular formulation, these include margarine/ice cream/crystallisation processes.

The FT25 has a number of configurations according to the required use. Armfield miniature-scale technology is well established at offering developers the opportunity to run small trials, which provide enough information to enable scale-up to larger plant with confidence.

The formulations go through similar physico-chemical changes as they would in production plant and real time data logging permits results to be recorded and repeated.



FT25 - 40 bar

## FEATURES & BENEFITS

- ▶ Simulates full-scale process
- ▶ Fast, accurate new product development
- ▶ All process parameters under operator control for maximum flexibility
- ▶ Rugged and reliable units
- ▶ Only requires electricity and water to function
- ▶ Full control of barrel speeds to over 1400rpm
- ▶ Temperature control system incorporated
- ▶ Integral control panel enabling simple control and monitoring of all major variables
- ▶ Enclosed self-contained, mobile, stainless steel service cabinet for easy cleaning and wash down with removable panels
- ▶ Stainless steel barrel with PEEK scrapers
- ▶ Hygienic design
- ▶ Made from 316 stainless steel
- ▶ In-cabinet refrigeration

FT25 - 20 bar



## Requirements



## Scraped Surface Heat Exchanger Systems - FT25X

Various configurations of heat exchangers, pin workers and air incorporation are available to fulfil a wide range of process requirements. All options provide variable control of the process throughput. With controllable process speed and up to two independent controls for rotational speed, a wide range of process variations can be explored.

### Typical configurations:

- ▶ Margarine Crystalliser
- ▶ Continuous Ice Cream Freezer
- ▶ Combined Margarine Crystalliser & Ice Cream Freezer
- ▶ Margarine / Spreads / Shortening Crystalliser





## Neutraliser/Washer/Bleacher - FT66

A floor-standing 25 litre batch processing vessel capable of carrying out the important pre and post refining stages of crude edible oils.

The three stages (neutralising, washing and bleaching) will:

- ▶ Turn the free fatty acids (FFA) into salt and water
- ▶ Remove any salt water and soaps generated during this process
- ▶ Filter the remaining material through a pressure leaf filter using diatomaceous earth as catalysts and filter aids

This will leave a clean oil of increased clarity and shelf stability.

### Requirements



## Hydrogenation Unit - FT67

This floor-standing unit enables efficient gas/liquid mixing under controlled conditions for the study of 'hardening' of edible oils.

Hydrogen is added under temperature controlled conditions with a Nickel Raney Catalyst.

By breaking the double bonds in the unsaturated oils, they become less reactive and therefore more shelf-stable. The trade-off in product shelf-life and ease of manipulation can then be explored.

The FT67 is a floor-standing batch processing vessel, used to adjust the degree of saturation of 25-litre batches of edible oils. An integral part of the edible oil processing line, for use in teaching/training and research and development.

### Requirements



## Deodorising Unit - FT68

A vacuum steam distillation unit, suitable for the removal of aromatic compounds from edible oils.

Using a combination of a multi-stage vacuum pump and steam stripping, extremely low values can be reached. This rapidly encourages the evaporation of volatile compounds, leaving an aroma-free oil.

The deodorising process vessel has a batch size of 25 litres and is mounted in a floor-standing stainless steel framework, which also houses the high-vacuum equipment, control console, discharge pump and polishing filter.

### Requirements





## Requirements



### Batch Solvent Extraction & Desolventising Unit - FT29

A floor standing, self-contained 25kg batch process unit demonstrating a variety of solid/liquid extractions.

It is particularly suitable for 'leaching' edible oil from oil-bearing seeds and desolventising both the extracted solids and the miscella.

- ▶ Single extraction/desolventiser vessel
- ▶ Solvent/water recovery tank
- ▶ All flameproof construction
- ▶ ATEX approved
- ▶ Operation of small-scale version of industrial processes
- ▶ A wide variety of solid/liquid extractions may be processed
- ▶ Small quantities (25kg) can be processed
- ▶ Low waste disposal rate



## Requirements



### Modular Cross Flow Filtration System - FT18-MKII

A small pilot-scale cross-flow filtration system designed to operate with a range of membrane module configurations.

It can be operated with as little as 5-10 litres of material to give data that is useful for process scale-up. It can be used over the full range of cross-flow filtration applications from microfiltration through to reverse osmosis.

- ▶ Integral data logging of all parameters
- ▶ Capable of Microfiltration / Ultrafiltration / Nanofiltration & Reverse Osmosis
- ▶ Ceramic, Spiral Wound, Tubular and Hollow Fibre membrane modules available



## Requirements



### Cross Flow Membrane Filtration - FT17

A lab-scale system for evaluating membranes in a cross flow filtration application enabling rapid determination of cross flow filtration performance using a range of membrane types with small product volumes (1 litre).

It can also be used in teaching applications to demonstrate features of different membrane types and the effect of varying filtration variables.

- ▶ Variable retentate cross flow velocity over the filtration membrane
- ▶ Data logging of filtration pressure, permeate mass, retentate flow rate, retentate temperature
- ▶ Electronic balance to measure filtration performance
- ▶ Buffer addition / Diafiltration capabilities
- ▶ Optional retentate temperature control (FT17-15) with operating temp range of 5-60 °C



# Pilot Line

Armfield equipment has been designed to be modular and can be sourced as a flexible solution that can be expanded upon as your business grows.

When a specific process is required, Armfield has the expertise and capability to create bespoke designs for a wide variety of products.

These are created based on Armfield's existing equipment or from first principals to give you the solution you need.



Raw product



UHT process line with integrated Bag-in-Box filler



Continuous and Batch Deaeration

200l/h Homogenisation



# Example Process Lines

Here, the customer had a very specific processing requirement that Armfield could meet and provide a complete installation and detailed training package.

This system required integration with other equipment on site with seamless communication and accuracy.

Raw pomegranate juice is fed into the process line where it is deaerated, homogenised, heat-treated, and filled in a sterile environment (or carbonated and filled).

The resulting product is a shelf stable juice processed to the detailed parameters required by the end user.











# Ingredient Preparation

Ingredients and constituents of the final products must sometimes travel large distances to where they are fully assembled.

To reduce the cost of this transportation some ingredients can be dehydrated at the source and rehydrated upon arrival at the final assembly site.

Products with a base of a common oil can be filtered to increase the concentration of the required ingredient, then diluted at the destination to the appropriate concentration.



FT32 Laboratory Drum Dryer



UOP10 Laboratory Steam Generator



FT142 Multifunction Laboratory Mixer UHT



FT80 Tall Form Spray Dryer





## Requirements

### Tall Form Spray Dryer/Chiller FT80/81

3Ph

COMP. AIR



The Armfield Tall Form Spray Dryer has been specifically designed to enable small quantities of product to be processed. The functional properties of the powders produced are comparable to large-scale production dryer capabilities.

The FT80 can be quickly and easily configured as a Spray Chiller (FT81) capable of handling products such as bakery shortening mixes containing high melting point fats to be converted from liquid to powder.

- ▶ Temperatures up to 250°C
- ▶ Max flow rate 7l/h
- ▶ Max evaporation rate 3l/h
- ▶ Measures relative humidity and all relevant chamber pressures.



## Requirements

### Computer Controlled Tray Dryer - UOP8-MKIIe

1Ph

PC

USB

The most commonly used industrial method of drying solids in bulk consists of passing a hot air stream over fixed trays of wet material.

This small pilot-scale tray dryer uses this method and is designed for laboratory training programmes. Operating conditions may be varied in a way that provides data demonstrating both theoretical and practical aspects of industrial drying practice.

This equipment is applicable to the unit operations laboratory and also to food technology education and research.



## Requirements

### Drum Dryer - FT32

3Ph



A steam-heated, nip fed twin cylinder roller dryer.

- ▶ Simple drying of a material to give moisture content and the drying time (or residence time) required
- ▶ Determination of drying curves to assess the feasibility of fluidised bed drying of a material on an industrial-scale. Drying curves are relevant to the mechanism of drying - they may be used as a basis for heat and mass balance, thermal efficiency of drying and dryer design
- ▶ Calculation of heat transfer coefficients for different conditions - important in dryer design and comparison of fluidised beds with other drying methods



## Requirements

### Blast and Fluid Bed Freezer - FT36

3Ph



A scaled-down insulated freezer cabinet combining two industrial processes for demonstration.

Independent control of the temperature and air flow on both tray and fluid bed sections enables a variety of conditions to be demonstrated.

- ▶ Rapid freezing of food simulating production scale processes
- ▶ Investigations of temperature changes within foods and similar items over varying times can be examined on the small batch scale





## Large Laboratory Process Chiller - FT64

The FT64 is a recirculating process chiller, providing a continuous supply of chilled liquid to serve as the cooling fluid when used with an Armfield miniature-scale processing unit.

The FT64 is particularly suitable for larger cooling duties and for use with the Armfield FT174X, FT94LT & FT94X systems.

### Features:

- ▶ Low refrigerant charge
- ▶ Low running costs
- ▶ Easily cleaned and maintained

Requirements



## Laboratory Process Chiller - FT63

The unit is a recirculating process chiller, providing a continuous supply of chilled liquid to serve as the cooling fluid when used with an Armfield miniature-scale processing unit. The FT63 is particularly suitable for use with an Armfield FT74XA UHT and FT174X systems.

### Features:

- ▶ Low refrigerant charge
- ▶ Low running costs
- ▶ Easily cleaned and maintained

Requirements



## CIP Unit - FT52

The Armfield FT52 has been designed to provide additional cleaning performance for Armfield FT units and other equipment.

It consists of a high flow rate stainless steel centrifugal pump mounted on a mobile frame

- ▶ Mobile unit with small footprint providing local CIP capability for pilot scale equipment
- ▶ Produces cleaning velocities in excess of the industry standard 1.5 m/s in Armfield systems
- ▶ Capable of flow rates up to 4.0 m<sup>3</sup>/h
- ▶ High pressure hygienic flexible hoses and fittings for quick connection to Armfield equipment
- ▶ 5l stainless steel hopper for cleaning solutions

Requirements







# Industrial Food Trials Laboratory

**Armfield's purpose built IFT laboratory can be used for testing, trial purposes and training**

- Trial:**
- ▶ Filtration
  - ▶ Homogenisation
  - ▶ UHT and HTST Processing
  - ▶ Sterile Filling
  - ▶ Carbonation, Filling and Capping
  - ▶ Spray Drying
  - ▶ Solvent Extraction
  - ▶ Crystallisation

## Trials in the USA

Our subsidiary Armfield Inc In New Jersey, USA, also has a trials facility for UHT/HTST processing and carbonation, filling and capping.



Contact us to find out more about developing your future successes:  
[sales@armfield.co.uk](mailto:sales@armfield.co.uk)





## Laboratory Pasteuriser - FT75

This is an example of the modern high temperature, short time (HTST) pasteurisers used in commercial food production.

It utilises a three stage plate heat exchanger and provides an excellent classroom example of the 'production line' approach to food manufacturing, complete with the associated systems and control aspects.

### Options include:

- ▶ CW-17 Chilled water circulator
- ▶ Data logging system FT75-DTA-ALITE
- ▶ Additional temperature sensor STS5

### Requirements

1Ph

PC

USB

COLD



## Fluidised Bed Dryer - FT31

A range of materials from fine powders to food particulates can be used on this versatile laboratory-scale unit.

- ▶ High rates of heat and mass transfer
- ▶ Less than 15 minutes drying time
- ▶ Digital readout display

### Requirements

1Ph



## Spray Dryer - FT30-MKIII

A bench top all-glass construction unit enabling continuous observation and measurement of this rapid drying process.

- ▶ 0-1.5 l/h product flow rate
- ▶ Air inlet temperature 200°C
- ▶ Can be used for beverages, heat sensitive material, dairy, plants, cereal and egg products

### Requirements

1Ph

COMP. AIR



## CentriPeel Centrifuge - FT27

All stainless steel basket type separator designed to save time. With an 9 litres per batch capacity and operating at up to 400G it reduces the time taken for gravity setting a liquid from several hours to a few minutes.

### Applications:

- ▶ Dairy
- ▶ Liquid Foods
- ▶ Pharmaceuticals
- ▶ Nutraceuticals
- ▶ Flavours & Fragrances

### Requirements

1Ph





## Requirements

### Oil Extraction Screw Press - FT28

3Ph

A small capacity continuous press suitable for extracting edible oils from a variety of oil bearing seeds.

- ▶ Oil extraction screw press suitable for use in the laboratory
- ▶ Complete with feed hopper, manual feed chute and oil discharge
- ▶ 4kW electric motor
- ▶ Suitable for use with a wide range of seeds or ground meals



## Requirements

### Laboratory Pasteuriser - FT43

1Ph

COLD

PC

USB

A bench top unit duplicating the industrial HTST process on a practical scale for teaching. Holding times can be varied with throughput and temperature controlled from a separate comprehensive control console.

Low viscosity food samples as small as one litre can be processed in batches, or continuously processed with a throughput of 20 l/hr.

- ▶ Tests can be carried out quickly and easily
- ▶ Data logging system FT43-DTA-ALITE
- ▶ Simulates the conditions used in a production plant
- ▶ Small quantities of liquid product can be processed



## Requirements

### Contact Plate Freezer - FT34-MKII

1Ph

USB

PC

COLD

DRAIN

The Contact Plate Freezer enables previously prepared and packed products to be quick frozen using an industrial freezing process.

Ideal for project work, it illustrates the improvements in taste and texture, which are obtained by a process achieving fast freezing times compared with the slower domestic freezer process times.

Freezing is an ideal application for demonstrating the importance of data logging. The five temperature sensor outputs are available for this.

An optional data logger is available which can be used to display the freezing curves on a computer. This illustrates the freezing characteristics and shows the Thermal Arrest Time, during which ice crystals are formed.

**Optional:** FT34-DTA-ALITE Data Logging Accessory:



## Requirements

### Vacuum Freeze Dryer - FT33-MKII

1Ph

A bench-top unit enabling lyophilisation of heat sensitive materials. Fully self-contained including vacuum pump.

- ▶ The unit is operated via a colour touchscreen with a graphing facility to show temperatures and vacuum level in real-time
- ▶ Products can be frozen in the chamber before drying
- ▶ Designed for freeze drying biologically heat-sensitive materials contained in beakers or other vessels
- ▶ It can be considered to be a small-scale replica of commercial-scale pharmaceutical and food production machines





## Rising Film Evaporator FT22

The Armfield evaporator processes samples as small as 2.0 litres under conditions identical to those in production, sufficient to reveal the effect of heating on any ingredients newly introduced to the recipe.

As well as investigation of the effect on organoleptic and physico-chemical properties, the equipment can be used to prepare product for taste trials on a daily basis to ensure the quality of incoming raw material is consistent.

Only 0.65m<sup>2</sup> of floor space is required to install the evaporator and it has been designed to fit easily into a room of standard height.

Applications include the concentration of:

- ▶ Juices (fruit and vegetable)
- ▶ Milk and milk products
- ▶ Extracts (non-flammable)
- ▶ Effluents
- ▶ Nutritional products

## Features and Benefits

- ▶ Small quantities of liquid products can be concentrated
- ▶ Easily cleaned and maintained
- ▶ Low product usage eases the disposal of waste
- ▶ Nominal throughput of 10 l/hr
- ▶ Single tube heat exchanger
- ▶ Integral CIP system
- ▶ Integral control console
- ▶ Integrated data logging and analysis

## Rising Film Evaporator - FT22

A floor-standing unit using the steam-heated, climbing film principle to concentrate small quantities of liquid foods either continuously or in batches.

This unit has an integrated data logger. The important process parameters can be varied and monitored.

- ▶ Only 2 litres of raw material required to test new products
- ▶ Max evaporation rate - 10 l/hr
- ▶ Integral CIP system.

## Requirements

1Ph	COLD
PC	DRAIN
USB	STEAM GENERATOR





## Requirements

### Butter Churn - FT21

1Ph

The Butter Churn provides practical training in the preparation of butter by the traditional method, and allows the investigation of the effect of process temperature and agitation time.

- ▶ 'Phase inversion' of the oil/water emulsion which occurs in churning
- ▶ Investigation of process temperature and agitation time in the agitation process
- ▶ Production of butter by various methods for quality and analytical determinations
- ▶ Mass balance quantitative yield of butter from various types of raw milk



## Requirements

### Autoclave - FT19

1Ph

A batch sterilising unit designed primarily for in-bottle production of sterilised milk.

- ▶ Highly portable autoclave requiring no plumbing to operate
- ▶ Time/temperature cycles can be defined to suit specific applications
- ▶ Sanitary 316 stainless steel construction and easily wiped down
- ▶ Lid is removable for full-width access



## Requirements

### Disc Bowl Centrifuge - FT15

1Ph

A self-contained centrifugal separator, demonstrating all aspects of cream/milk separation. Instrumentation is provided to measure varying bowl speeds and throughput rates.

Ancillary equipment for investigation into this type of separation consists of:

- ▶ Optical tachometer
- ▶ Product collecting vessels
- ▶ Stop clock
- ▶ Tools

The backboard includes a sectioned diagram detailing the component parts of the separator bowl and describing its mode of operation.



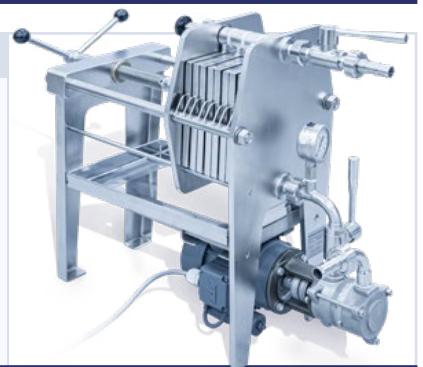
## Requirements

### Plate and Frame Filter Press - FT14

1Ph

A small plate pack conveniently mounted on a stainless steel framework, enabling clear demonstration of mode of operation.

This type of filter is widely used in the food, pharmaceutical, brewing and distilling industries. Several grades of filter media are supplied.



## Requirements

### Hammer/Beater Mill - FT2

1Ph

3Ph

A hammer mill, that is safe to operate and can be easily dismantled for cleaning. Designed for general laboratory grinding, the bench top unit is supplied with eight perforated plate screens.

#### Applications

- ▶ Seeds
- ▶ Nuts
- ▶ Other Biomass



# armfield assist



Armfield Assist is here to help, we have a 24hr online support portal where you can contact us or raise a support ticket, let us know what you need, installation, commissioning, advice, spares or technical back up.

Register or Login into the Armfield Assist Helpdesk Portal this will allow you to view, chase, edit or update your tickets at any time.



**Tickets can be created by either:**

- ▶ Visiting our Help Desk Portal at [www.armfieldassist.com](http://www.armfieldassist.com)
- ▶ Emailing [helpdesk@armfieldassist.com](mailto:helpdesk@armfieldassist.com)
- ▶ Calling our Support Team on +44 1425 478 781



**Trial Facility's**

Armfield have trials facilities in both Europe and the United States

Each facility has a selection of our equipment for industrial trials, check for availability or to arrange your trial now.

To book your trial with our experts

Europe : +44 (0)1425 478781

USA: +1 (609) 208-2800

**Installation and Commissioning**

Armfield offer global installation, commissioning and training by our highly experienced experts.

If you need assistance please contact our professional services team.

Contact us at [ict@armfieldassist.com](mailto:ict@armfieldassist.com)

**Customer Training**

Depending on your requirements, we can train individuals or groups, either on site or at our training facility.

Contact us at [ict@armfieldassist.com](mailto:ict@armfieldassist.com)





## Custom Projects, Design, Software and Aesthetics

Armfield's team of Engineers continue to build on a comprehensive portfolio of original and innovative designs.

We are world leaders in educational products and flume technology for teaching and research and pioneers of the "Pilot Scale System that allows industrial food technologists small-scale simulation of large scale performance".

Our cutting-edge production facilities, talented engineers, software designers and installation team all work to ensure that top quality products are delivered to your facility, every time.

### Custom projects

Advancements in technology ensure that Armfield's portfolio continues to develop and evolve.

We are keen to collaborate with universities and specialists to create bespoke production solutions against complex requirements and client concepts.

Our Project Management team are on hand to see your requirement through to completion.



### Manufacturing

As an ISO 9001:2015 certified business, Armfield strives for quality.

We work continuously with our suppliers, contractors and production facilities to ensure that your product arrives on time, on budget and to specification.

### Design

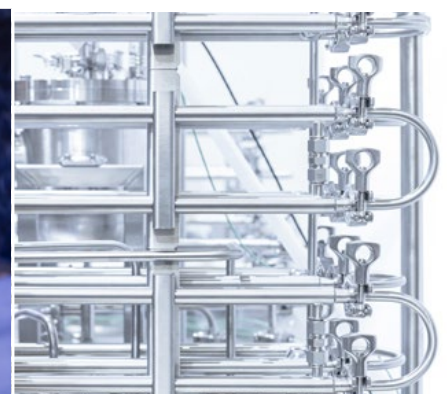
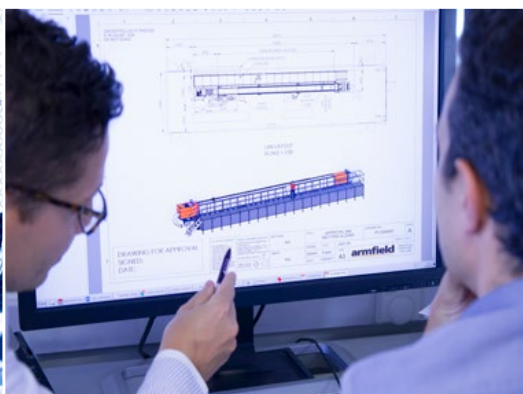
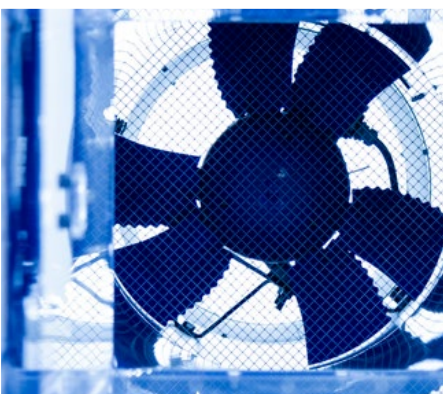
Products are conceptualised, developed and detailed using the latest computer-aided design software.

Coupled with computational fluid dynamics (CFD) & Finite Element Analysis (FEA) and 3D-print prototyping, our design process helps to ensure products are right first time.

### Aesthetics

Armfield is extremely proud of its brand identity: finished in striking blue and orange, each of our products are easily recognisable.

High quality materials including, composites, stainless steels and engineering plastics are used throughout our product range to ensure reliability in the harshest environments.



# armfield

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Armfield products are distributed throughout the world. It is our policy in most countries to deal direct or through proven and accredited sales agents, who after suitable approval, may become exclusive representatives.

In exchange for this exclusivity they are required to offer a comprehensive service including the highest degree of after sales support.

## Customer Demonstration

To arrange a demonstration please contact your local Armfield representative. Details can be found on our website here: [www.armfield.co.uk](http://www.armfield.co.uk), or contact Armfield HQ directly using the information below.

Your local Armfield Agent:



## armfield worldwide

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